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Input for Bulgaria’s Research and Innovation Strategies for Smart Specialization

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**CURRENCY AND EQUIVALENT UNITS**
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Currency Unit = BGN (Bulgarian Lev)
US$1 = 1.49528 BGN
1 BGN = US$0.66

**WEIGHTS AND MEASURES**

**Metric System**

**ABBREVIATIONS AND ACRONYMS**

3S Smart Specialization Strategy  
BAS Bulgarian Academy of Sciences  
BDA Bulgarian Drug Agency  
BPO Business Process Outsourcing  
BURS Bulgarian Universities Ranking System  
CCI Cultural and Creative Industries  
CCU Central Coordination Unit  
CEG Council For Economic Growth  
CEO Chief Executive Officer  
CNIC The National Innovation Council for Competitiveness of Chile  
COM Council of Ministers  
CR&D Collaborative Research and Development Programme  
DCE Department of Chemical Engineering  
EC European Commission  
EGA European Generic Medicines Association  
EPS Expert Panels  
EVIC Electric Vehicles Industrial Cluster  
FDI Foreign Direct Investment  
FP7 Seventh Framework Programme  
GDP Gross Domestic Product  
GOB Government of Bulgaria  
GPRA Government Performance and Results Act  
HAACP Hazard Analysis and Critical Control  
HAC Higher Attestation Commission  
HEI Higher Education Institutions  
IAC Innovation Advisory Council  
ICT Information And Communication Technology  
IP Intellectual Property  
IPO Initial Public Offering  
IPR Intellectual Property Rights  
MBE Machine, Building and Electronics  
M&E Monitoring and Evaluation  
MEE Ministry of Economy and Energy  
MES Ministry of Education and Science  
NATT National Association for Technology Transfer  
NEAA National Evaluation and Accreditation Agency  
NGO Non-Governmental Organization  
NCI National Council for Innovation for MEE  
NCSR National Council for Scientific Research for MEYS  
NKIB National Knowledge and Innovation Board
Effective Management of Operational Programme “Development of the Competitiveness of the Bulgarian Economy” 2007-2013, financed under Priority Axis 5 “Technical Assistance” of the Operational Programme, co-financed by the European Union through the European Regional Development Fund

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NIF National Innovation Fund
NIS National Innovation Strategy
NRP National Reform Program
NSF National Science Fund
NSRF National Strategic Reference Framework 2007-2013
OP Operational Programs
OPC Bulgaria’s Operational Program on Competitiveness 2007-2013
OPIC Bulgaria’s Operational Program on Innovation and Competitiveness 2014-2020
OTC Over-The-Counter
PA Priority Axes
PIAAC Programme for the International Assessment of Adult Competencies
PROs Public Research Organizations
R&D Research and Development
RDIs Research and Development Institutes
RIS Research and Innovation Strategy
RISS Regional Innovation Strategy of Slovenia
SBIR U.S. Small Business Innovation Research
SMES Small And Medium Enterprises
STPC Science and Technology Policy Council of Finland
TTOs Technology Transfer Offices
UKF Unity Through Knowledge
UMC United Milk Company
US DOE United States Department of Energy
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Preface

In the context of an adverse external economic environment and challenging demographics at home, improvements in the living standards and long-term growth can be catalyzed through smart investments in innovation, research and human capital. The European Union launched the Smart Specialization Strategies initiative, a new approach to economic development that is anchored on targeted support for research and innovation. Bulgaria’s government led by the Ministry of Economy and Energy is currently preparing the country’s Smart Specialization Strategy. This will be the basis for Structural Fund investments under the Cohesion Policy's contribution to the Europe 2020 jobs and growth agenda.

This report provided “Inputs to Bulgaria’s Research and Innovation Strategies for Smart Specialization. It presents a comprehensive assessment of the country’s governance structure, innovation facilitating instruments, and key innovation assets –research and human capital. It proposes a stronger monitoring and evaluation (M&E) framework and provides a sectoral analysis of five priority sectors of the economy and their innovation potential.

The report’s key findings are that Bulgaria’s innovation system is operating below its potential, whether measured by the system’s inputs and outputs or by the contribution of innovation to economic growth. The low level of R&D spending, in particular by the enterprise sector, along with the weak linkages between research and the needs of the productive sector, are key reasons for Bulgaria’s comparatively poor record of innovation. Future growth could be boosted if Bulgaria takes the steps to become a knowledge economy, with high value-added products and services in industries where the country already has some competitive advantages.

Bulgaria has emerging export-oriented industries with substantial growth upside. These emerging industries could flourish and generate high-skilled employment with the right mix of private investment in innovation, complementary public investments in research and human capital, and a more favorable business environment. The sectoral analysis in this report is organized around case studies that cover five sectors that are already economically important but could see stronger dynamics through innovation and technology transfer – food processing, machinery building and electronics, pharmaceuticals, information and communication technology (ICT), and culture and creative industries. Building on extensive consultations with industry participants, government, academic institutions and think tanks, the report identifies strengths and weaknesses in these sectors, industry trends, and opportunities for targeting economic policies in a more effective way.

An in-depth evaluation of Bulgaria’s innovation system reveals three major aspects related to the public support for research and innovation that, if addressed by the government, could dramatically improve the incentives to invest in innovation and technology adoption:
a) **Effective implementation of innovation support programs.** With the next cycle of the EU Operational Program 2014-2020 about to begin, the government has the opportunity to use the experience of the previous cycle to ensure that the funds are used to support projects that have the greatest potential to ignite the country’s innovation agenda. Strategic concentration of limited resources in a few key areas will be needed to ensure that those resources are spent where they will have the highest impact on the economy.

b) **Improving coordination among governmental bodies.** There is no effective central body in charge of the innovation agenda; instead, responsibilities are dispersed among multiple ministries and agencies, leading to a dilution and duplication of efforts. Establishing a National Knowledge & Innovation Board, which acts as coordination body at the cabinet level to oversee and manage the innovation agenda would go a long way to improving the impact of the government’s interventions in the development of the national innovation system.

c) **Emphasizing accountability for results.** There needs to be rigorous and constant monitoring and evaluation (M&E) of results framework in place. This will allow for changes to be made in response to information about the system’s performance. Integrating a strong M&E framework into the design of Bulgaria’s Smart Specialization Strategy, as proposed by the European Commission, will help to maximize the impact of activities and investments.

The preparation of the draft version and the final version of this report entailed extensive consultations with a variety of counterparts and stakeholders in order to make the report’s findings as inclusive and encompassing as possible. Several inter-ministerial meetings were chaired by the Ministry of Economy and Energy to discuss innovation policy and weaknesses in the implementation sphere. This was complemented by thematic workshops and sector-specific focus groups covering different topics, including the results of the Operational Program Competitiveness 2007-2013, the potential to integrate more powerful support instruments, innovation commercialization and the intellectual property rights regime. The report has also benefitted from the constructive feedback by the European Commission’s experts in the DG Research and Innovation and DG Regional Policy, the European Investment Fund and the Joint Research Centre office in Seville.

The World Bank looks forward to continuing the partnership with the Government of Bulgaria in the area of innovation. The results to date show the enormous value from bringing together global and national experts to discuss and analyze the possibilities to accelerate innovation and technological upgrading through smart public policy interventions that build on the country’s competitive advantages.

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World Bank
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Preparation of the report was coordinated by Feyi Boroffice (Private Sector Development Specialist, ECSPF) and John Gabriel Goddard, with contributions from an extended team of World Bank staff and consultants. Feyi Boroffice served as the author of Chapter 2 on Business Innovation. Eduardo Bitran Colodro (Professor at Adolfo Ibañez University in Chile, former President of the National Innovation Council for Competitiveness in Chile and former Director General of the Chile Foundation) and Juan Julio Gutierrez (Private Sector Development Specialist, ECSPF) wrote Chapter 3 on Governance. John Gabriel Goddard and Yulia Vnukova (Private Sector Development Analyst, ECSPF) prepared Chapter 4 on Research. Chapter 5 on Human Capital was completed by Boyan Zahariev and Ilko Dimitrov (Education Experts from the Open Society Institute-Sofia) and Roberta Malee Bassett (Senior Education Specialist, ECSSH2). Chapter 6 on Monitoring and Evaluation was written by Murat Seker (Economist, FIEEI) and Eva Vivalt (Young Professional, EASFP). Chapter 7 on the Sectoral Analysis was undertaken by a team composed of Evgeni Evgeniev (Private Sector Development Specialist, ECSPF), Christian Filipov (Private Sector Development Specialist, ECSPF), and Kostadin Stoilov (Industry Expert).

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Executive Summary

A. Introduction

1. This report provides inputs for Bulgaria’s Research and Innovation Strategies for Smart Specialization (RIS3) through a comprehensive assessment of the country’s governance structure, innovation facilitating instruments, and key innovation assets – research and human capital. As part of the Knowledge and Advisory Services Program on Innovation, the report supports the development of a Smart Specialization Strategy, which should serve as the impetus for the upgrading of Bulgaria’s research and innovation capabilities. The EC considers investing more in research, innovation and entrepreneurship as a crucial component for the future success of Europe, and has determined that the approval of a Smart Specialization Strategy (see Box 0.1) should be an *ex ante* conditionality for access to Cohesion and Structural Funds in the 2014-20 period.

Box.0.1: What is Smart Specialization?

Smart specialization is a strategic approach to economic development through targeted support to research and innovation (R&I). It will be the basis for Structural Fund investments in R&I as part of the Cohesion Policy's contribution to the Europe 2020 jobs and growth agenda. More generally, smart specialization involves a process of developing a vision, identifying competitive advantage, setting strategic priorities, and making use of smart policies to maximize the knowledge-based development potential of any region, strong or weak, high-tech or low-tech.


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1. This is an agreement between the Government of Bulgaria and the World Bank to support the Government’s efforts, and in particular those of the Ministry of Economy and Energy (MEE), to strengthen the national innovation system at both the institutional and policy levels.
2. **Bulgaria’s innovation performance over the last decade has fallen short of expectations.** The innovation system is operating below its potential, whether measured by the system’s inputs (see Table 0.1 on R&D spending), outputs (see Table 0.2 and Table 0.3 on patents), or by the contribution of innovation to economic growth (see Figure 0.1 on high-tech exports). This is despite the adoption of a National Innovation Strategy in 2004 and its amendments in 2006, the development of a National Reform Program 2011-2015 (which sets concrete targets for increasing R&D from 0.6 percent of GDP in 2012 to 1.5 percent by 2020), and the preparation of innovation studies for different regions of the country over the past decade. A low level of R&D spending, in particular in the enterprise sector, along with the almost nonexistent linkages between research and the needs of the productive sector, and the challenging demographics of the society as a whole, are key reasons for Bulgaria’s comparatively poor record of innovation.

![Table 0.1: Bulgarian Firms’ Innovation Performance Relative to the EU-27 average](image)

<table>
<thead>
<tr>
<th></th>
<th>BG</th>
<th>EU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business R&amp;D expenditures</td>
<td>0.3%</td>
<td>1.23%</td>
</tr>
<tr>
<td>Public R&amp;D expenditures</td>
<td>0.29%</td>
<td>0.76%</td>
</tr>
</tbody>
</table>

*Source: EC Innovation Union Scoreboard 2011.*

![Figure 0.1: High-tech Manufacturing Exports (% of total)](image)

Bulgaria, Croatia, Hungary, Lithuania, Romania, Turkey, Finland

*Source: World Development Indicators*

![Table 0.2: Patents Granted by USPTO (per million Inhabitants)](image)

<table>
<thead>
<tr>
<th>Country</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgaria</td>
<td>6</td>
<td>16</td>
<td>36</td>
<td>58</td>
<td>43</td>
</tr>
<tr>
<td>Hungary</td>
<td>47</td>
<td>66</td>
<td>46</td>
<td>91</td>
<td>100</td>
</tr>
<tr>
<td>Romania</td>
<td>11</td>
<td>12</td>
<td>8</td>
<td>16</td>
<td>34</td>
</tr>
<tr>
<td>Turkey</td>
<td>19</td>
<td>16</td>
<td>19</td>
<td>29</td>
<td>41</td>
</tr>
<tr>
<td>Croatia</td>
<td>15</td>
<td>14</td>
<td>16</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Finland</td>
<td>850</td>
<td>824</td>
<td>864</td>
<td>1143</td>
<td>951</td>
</tr>
</tbody>
</table>

*Source: USPTO, data on utility patents, accessed November 2012*

![Table 0.3: Patents Granted by EPO (per million inhabitants)](image)

<table>
<thead>
<tr>
<th>Country</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgaria</td>
<td>0.8</td>
<td>0.5</td>
<td>0.7</td>
<td>0.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Hungary</td>
<td>3.5</td>
<td>4.8</td>
<td>3.8</td>
<td>5.8</td>
<td>4.6</td>
</tr>
<tr>
<td>Romania</td>
<td>0.2</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Turkey</td>
<td>0.5</td>
<td>0.7</td>
<td>0.8</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Croatia</td>
<td>3.2</td>
<td>2.9</td>
<td>3.4</td>
<td>2.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Finland</td>
<td>144.0</td>
<td>154.3</td>
<td>124.3</td>
<td>126.6</td>
<td>109.0</td>
</tr>
</tbody>
</table>

*Source: EPO Annual Reports, WDI*

3. **Bulgaria’s future economic growth is dependent on its becoming a knowledge economy, with high value-added products and services being the key competitiveness drivers.** The economic crisis exposed weaknesses in the economy, notably the fact that low-skilled manufacturing, services, and construction sectors had been leading the generation of employment and economic growth. High-value
products and services remain a negligible part of exports, and the country’s skills and technological capabilities have remained stagnant. This trend is reflected in Bulgaria’s export and technological performance and competitiveness rankings, as benchmarked against comparator countries. Furthermore, there was low absorption of the EC OP Competitiveness funding (€1,162 million), the main source of public funds available for upgrading and modernizing Bulgaria’s economy over the 2007-2013 cycle. Reversing this trend will require a shift in approach and philosophy. Research and innovation can help Bulgarian industries to move up the value chain in knowledge-intensive industries, thereby increasing its share of high-tech exports and improving employment opportunities for advanced human capital, generating a virtuous circle of growth and better opportunities for the people of Bulgaria.

4. There is a clear positive correlation between ICT development and the competitiveness of a country, which presents opportunities for a country like Bulgaria. Studies indicate a positive correlation between different economic outcomes and broadband penetration, the proportion of citizens who are regular internet users and the proportion with good computer and internet skills. The ICT skills gap between Bulgaria and the EU trickles down into slower development of ICT professionals in the economy and has a negative impact on the take up of e-commerce, e-government, e-practices in general. While progress was made in the establishment of e-government services, there are interrelated impediments to a broadband enabled transformation such as low broadband take-up and partial rural broadband coverage.

5. An evaluation of Bulgaria’s innovation system reveals three major public policy aspects that, if addressed by the government, will dramatically improve the innovation agenda.

a. Effective implementation of innovation support programs. With the next cycle of EU Operational Program 2014-2020 about to begin, the government has the opportunity to use the experience of the previous cycle to ensure that the funds are absorbed by those who have the greatest potential to ignite the country’s innovation agenda, leading to the closing of the competitiveness gap between the country and the EU. By addressing the issues related to implementation of the program, the government will be able to amplify the impact of its efforts to address the shortcomings in research and human capital formation that currently hamper the innovation efforts of industry. Difficult choices will need to be made to target funding to the universities and research institutes that are producing results, and limit funding to those that are not. In the area of business innovation, simplifying the procedures and re-examining the criteria and process for administering funding will increase absorption and ensure that high-impact innovative firms in the enterprise sector are the ones that receive funding. Furthermore, strategic concentration of limited resources in a few key areas will be needed to ensure that those resources are spent where they will have the highest impact on the economy.

b. Improving coordination among governmental bodies. The innovation performance of the Bulgarian economy depends especially on (i) the absorptive capability of firms, and (ii) the ability to develop science and research capabilities and advanced human capital relevant to the
current and futures needs of key sectors. These functions are supported by several government bodies in Bulgaria. There is no effective central body in charge of the innovation agenda; instead, responsibilities are dispersed among multiple ministries and agencies, leading to a dilution and duplication of efforts. Establishing a Coordination Body at the cabinet level to oversee and manage the innovation agenda would go a long way to improving the impact of the government’s interventions. The closure of applied research institutes early in the transition effectively ended the government-coordinated relationship between research and industry; both the research and enterprise sectors look mostly outside of Bulgaria for collaborative efforts, while the bulk of research conducted in the research institutes has little relevance to the domestic economy. In addition, the limited funding for research in the universities has reduced the attractiveness of careers in science and engineering among recent graduates. By better coordinating its efforts, the government can encourage research, human capital formation, and business to collaborate in a synergistic manner, which is essential for the country’s transition to a knowledge economy.

c. **Emphasizing accountability for results.** For the innovation system to function properly there needs to be rigorous and regular monitoring and evaluation of results. This will allow for changes to be made in response to information about the system’s performance. Integrating a strong M&E framework into the design of the Smart Specialization Strategy, as proposed by the European Commission, will help to maximize the impact of activities and investments. Such a framework will provide the foundation for an evidence-based innovation strategy – one based on the identification of what works, what does not work and why, and how the strategy can be adapted and improved over the 2014-2020 period. The use of performance contracts to monitor the progress of relevant government bodies and programs should reduce agency problems. In addition, transparency across the system should be promoted with a comprehensive evaluation process incorporated in the program design.

6. **The EC has published detailed guidelines to help with the development of RIS3 strategies.** In line with EC guidelines, the report covers the following areas:

   a. **Analysis of the context and potential for innovation:** Chapter 4 (Research) includes an in-depth assessment of Bulgaria’s research and innovation infrastructure and provides recommendations on how they can be upgraded. The linkage of the country’s researchers with the rest of the world (and Europe in particular) is also addressed at length in this chapter, with recommendations on how to strengthen these linkages through increased collaborative

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efforts. Chapter 5 (Human Capital) addresses how the government can incentivize the universities to produce skills relevant for the innovative sectors of the economy. Chapter 2 (Stimulating Innovation and High-Impact Entrepreneurship) examines the dynamics of the entrepreneurial environment and the tools available to the government to meet the need of innovative entrepreneurs.

b. **Set up of a sound and inclusive governance structure:** The report adheres to the EC’s premise that stakeholders of different types and levels should participate extensively in development of the innovation agenda. Chapter 3 (Governance) examines best practices across the world and provides specific recommendations on how to best achieve sound and inclusive governance of Bulgaria’s innovation system.

c. **Production of a shared vision about the future:** The EC proposes that countries should develop a comprehensive vision for their economic future that is shared by all stakeholders. Chapter 2 introduces the concept of technology road-mapping, a collaborative process for developing common innovation goals. Engaging in this process will enable Bulgaria to develop a vision that is inclusive and therefore has a much higher chance of success.

d. **Identification of priorities:** The objective of this report is to assist the government in identifying the areas of focus for stimulating innovation and accelerating Bulgaria’s transformation to a knowledge economy. The Sectoral Analysis presents case studies on several key sectors, to provide a context for policy discussions. Consolidating the governance mechanisms, as described in Chapter 3 (Governance), will ensure a coordinated process in which all ministries and government bodies are aligned and focused on the same priorities.

e. **Definition of a coherent policy mix, roadmaps, and action plan:** The report includes a candid assessment of the current policy mix and instruments used to stimulate innovation. It also provides examples of best practices and stumbling blocks; and recommends changes to the current mix of instruments to support innovation. Once the strategy is finalized, it will be important to engage all stakeholders in dialog about how to design a roadmap and action plan to ensure successful implementation.

f. **Integration of monitoring and evaluation mechanisms:** The EC emphasizes the importance of integrating mechanisms for monitoring and evaluation in the strategy and its different components (i.e., from the strategic overall objectives to the specific objectives of each of its actions) from the very beginning. Chapter 6 (Monitoring and Evaluation) describes in detail how the government should go about doing this, and provides guidance on the design of a comprehensive M&E framework.
B. Overview of the report

7. The concept of Smart Specialization is “one where each region builds on its own strengths, to guide priority-setting in national and regional innovation strategies.” The objective of the Smart Specialization Strategy is to increase the impact and relevance of R&D through a fact-based consultative process that allows for “self-discovery” (David, Foray and Hall 2009). A smart specialization approach works with the industrial and economic grain of the country or region, using capabilities that have been developed over time to underpin its innovation potential. The challenge is that these capabilities are also highly specific, which can limit opportunities for entrepreneurs. That is why upgrading and diversifying those capacities are easier when countries move to nearby activities that exploit and redeploy existing assets. Smart specialization also justifies some degree of targeting to assist clusters that emerge in a largely neutral and competitive policy environment. Developing a Smart Specialization Strategy will help the government to ensure that the investments will have a significant economic impact through the revamping of relevant legislation, funding programs, and the capacity of the public administration.

8. In keeping with the approach put forth by the EC, the report is based on broad consultations with members of the government, private sector, academia, and civil society. The report examines the key factors affecting the development of a vibrant and well-functioning national innovation system, and concludes with case studies on five key sectors where there is potential to benefit from an increase in innovation-driven investment. The report covers the following areas:

**Entreprenurship: Stimulating innovation and high-impact entrepreneurs**

9. This chapter outlines how the government can more effectively use the instruments at its disposal to stimulate innovation and high-impact entrepreneurship. The chapter discusses the role of government in removing obstacles to entrepreneurial activity and providing the appropriate incentives and legal and regulatory framework for innovation. It assesses the market failures that underlie the need for this support, evaluates the most appropriate instruments for Bulgaria, and discusses how these instruments can be improved.

10. The Bulgarian enterprise sector is dominated by microenterprises with fewer than 10 employees; these enterprises accounted for 91 percent of all companies and employed 29 percent of the workforce in 2008-2010. Micro and small firms face a number of obstacles to becoming innovative that negatively impact their potential for growth and, in many cases, their survival. A core objective of the Smart Specialization Strategy must be to address these obstacles, to enable small companies with little

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3 Ibid.
impact on the economy to become high-impact innovators that are actively engaged in developing new products and processes.

![Innovative Characteristics of SMEs](image)

**Figure 0.2: Innovative Characteristics of SMEs**

11. **Due to market failures, the ability of entrepreneurs to experiment and bear associated risks is largely dependent on the availability of financial and non-financial support to create new firms and grow existing enterprises.** To create an environment that stimulates business innovation, the government should aim to address the need for: (a) well-designed guidelines for intellectual property rights (IPR), to facilitate uptake and increase the incentives to innovate; (b) technology road-mapping to bring stakeholders together to develop common innovation goals; (c) effective funding mechanisms; and (d) a coordination mechanism to ensure that all stakeholders are engaged. Given that interventions in the area of innovation carry a high degree of risk, the design of any instrument should be guided by the principles of transparency and additionality.

12. **Bulgarian legislation on intellectual property is in line with EU directives, but it has failed to spur indigenous innovative activity due to the problems with effective protection.** Legislation on patent protection and registration of utility models is well developed and covers the key areas of new discoveries, scientific theories, and mathematical methods. The law puts no restrictions on the use of intellectual property for collateralization purposes; and research institutions, including universities, are given broad discretion in controlling their intellectual property rights. Although these measures have reduced unlawful appropriation of IP, their implementation remains uneven, and the uptake by the private sector has been minimal and predominantly limited to patents generated through international collaborative efforts.
13. **Putting in place effective IPR protection will increase the incentive for businesses to invest in R&D by removing the risk of rapid imitation.** To do this, the government will need to revise IPR guidelines pertaining to government-funded research, joint public/private and academic/private research. Government can encourage use of the IP system by enhancing knowledge of all its elements – not only patents, but also trademarks, geographical indications, industrial designs, utility models, etc. Streamlining the IPR application process, making the dispute prevention and resolution process more effective and reducing transaction costs would also facilitate its use by inventors, researchers, entrepreneurs, and SMEs. The recent approval in January 2013 of an EU unitary patent system is a welcome development and should facilitate the protection and management of IPR in Bulgaria.

14. **Bulgaria’s fragmented policymaking process in the areas of research, advanced human capital formation, technology development, and promotion of business innovation has diluted the impact of business innovation instruments.** Technology road-mapping, a sector-specific exercise that identifies challenges, forecasts emerging market requirements, and pinpoints technology gaps and the R&D needed for the sector to become more competitive, would improve coordination among actors in the system, and thus increase the effectiveness of government intervention. Experience has shown that combining a top-down process whereby key sectors are pre-identified with a bottom-up process whereby new and emerging sectors self-identify, can generate competition among different sectors for access to state-provided public goods. Both approaches require active stakeholder engagement to be successful, with the government’s role limited to providing seed money for road-mapping, and to bringing important sector stakeholders together and facilitating discussions. The government would take an active role toward the end of the process, as the policy implications of the discussions become clearer and the recommendations are transformed into programs and policy initiatives designed to meet the current and future needs of firms in that sector.

15. **A significant obstacle to achieving the optimal level of innovation in an economy is the lack of incentives for funding innovative entrepreneurship and commercialization of research.** While access to credit is essential to SMEs and has a direct impact on total factor productivity, the intangible nature of technological innovation and the uncertainty of results make it difficult for SMEs to obtain financing. Innovative entrepreneurship requires specialized platforms and financial instruments for proper development; the most important of these are matching funds, early stage funding, and – once a critical mass of innovative entrepreneurs is established – venture capital.

16. **There is significant room for improving and expanding the current innovation funding instruments.** The OPC makes extensive use of matching grants, and while they are effective in encouraging firms to share and manage risk, and allow for specific targeting on a case-by-case basis, they are tremendously difficult to administer and require specialized expertise to evaluate. Designing matching
funds to support innovative activities in firms is a fundamental first step toward the development of suitable market mechanisms. To that end, an in-depth examination of the OPC resulted in the following recommendations:

- **Further institutional reforms are critical to improve policy design and implementation.** Despite recent institutional changes, Bulgaria’s OPC management structure needs further reform as: (i) the institutional setup is not in line with international good practices, which suggest that channeling public resources via an independent, specialized agency is the most effective way to manage public resources targeting innovation; (ii) the OPC Managing Authority (MA) lacks human capital with the right mix of experience, as well as the long-term perspective needed to develop the capacity for effective implementation; (iii) MEE would need to play a stronger role at the policy level and lead the dialogue among stakeholders on the country’s innovation policies and programs.

- **Current project selection and evaluation processes have been a key factor hampering OPC implementation.** Although the OPC MA introduced a number of measures aimed at facilitating the absorption of OPC funds, both financial and material implementation of these measures have been largely lagging. A key factor is the project selection process, which is complex, lengthy, not sufficiently transparent, and favors projects that comply with administrative criteria independently of their quality or innovative potential. Simplifying the selection and evaluation process is essential for the effective implementation of OPC programs and for attracting high-quality applicants.

- **It is critical that project evaluators have significant technical and market expertise.** The technical project evaluation process does not involve a sufficient number of evaluators with adequate technical and commercial experience. It is strongly recommended that OPIC engages independent experts, including foreign peer-reviewers, with the right credentials to assess the merits of the idea. Such an approach would facilitate the evaluation process and guarantee the quality of the project assessment.

- **The measures supporting business innovation could be further improved.** In order to enhance OPC absorption and attract a larger pipeline of innovation projects, it is recommended to reorient the focus on administering the program from one of risk aversion to one of risk management. The process will entail: (i) reducing the number of the eligibility

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4These recommendations on improving the matching grants program are discussed in extensive detail in the World Bank report, “Supporting Innovation through OPC 2007-2013: A review and options to enhance results in the period 2014-2020,” prepared under the Bulgaria Reimbursable Advisory Services Innovation Program.

5 Formerly, the Ministry of Economy, Energy and Tourism (MEET) (2009-2013).
criteria by selecting the most relevant ones in order to attract more applications; (ii) redesigning the scoring criteria to underline technical and market criteria; (iii) improving guidelines for applicants to enhance the quality of applications; (iv) expanding activities educating the applicants about preparation of the project applications; (v) providing clear guidelines for the applicants about the timeline and milestones of the application process, and (vi) developing a risk based review process where beneficiaries are audited on a sample basis and those who are found to be out of compliance with the requirements are heavily penalized.

e. **The new OPIC for the 2014-2020 cycle (OPIC) is an opportunity to introduce new innovation instruments targeting various stages of the innovation value chain.** The OPIC will mostly likely be the primary public source of innovation finance in the 2014-2020 perspective. In order to complement already existing innovation instruments and address existing gaps in supporting all stages of the innovation value chain, there is a menu of new instruments that would complete and boost Bulgaria’s national innovation system: (i) Business incubators that include early stage investment funds; (ii) Proof of Concept Labs which will support prototyping and piloting for product innovation; (iii) A Network of Technology Transfer Offices with an off-campus office providing specialized services in research commercialization; (iv) Programs promoting collaboration with Bulgaria’s highly skilled Diaspora that would result in connection to the global knowledge networks and innovation experts; (v) Innovation Vouchers for SMEs that would encourage behavioral change in SMEs in traditional sectors towards innovation (see Table 0.4).

f. **Strengthening monitoring and evaluation in the OP.** Options that exist include having a richer set of indicators that balance outputs and outcomes, introducing rigorous impact evaluation to measure the additionality of different instruments and improving the coordination with other ministries so that the results achieved are visible.

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Rationale</th>
<th>Best practices</th>
</tr>
</thead>
</table>
| **Business incubators/Venture accelerator** | • Identification of hi-tech startups and investment in innovative business ideas  
  • Facilitate knowledge diffusion and technological upgrading in low and medium-tech sectors | • Focus on picking the best ideas  
  • Use of incentives that will incubate high-growth businesses  
  • Strong involvement of universities  
  • Evaluation committee of business experts should make financing decisions |
| **Proof of concept labs for prototyping and piloting** | • Removes barriers such as start-up funding, access to equipment, and access to expertise | • Type of lab should be conditioned on private sector interest |
| **Technology Transfer Office Network** | • Optimization of technology transfer services in a cost-effective way | • Having TTOs specialize in different areas to foster collaboration and innovation |

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*Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme “Development of the Competitiveness of the Bulgarian Economy” 2007-2013”, financed under Priority Axis 5 “Technical Assistance” of the Operational Programme, co-financed by the European Union through the European Regional Development Fund*
In this model, the activities of TTOs will focus on: i) technology transfer promotion, ii) assessment of the demand for technology transfer, and iii) potential disclosures; while off-campus office is responsible for technical assistance in the process of knowledge commercialization.

<table>
<thead>
<tr>
<th>Diaspora Collaboration Program</th>
<th>For a country with a significant diaspora, this is an effective way for enhancing the transfer of the global stock of knowledge, which is critical for an economy innovation and competitiveness.</th>
<th>Initiatives promoting diaspora entrepreneurship have been developed across various countries and with different focus, e.g. research, networking mentoring, training and venture capital partnerships</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation Vouchers</td>
<td>Encouraging behavioral change in SMEs in traditional sectors towards innovation through technical assistance.</td>
<td>Simple application process</td>
</tr>
<tr>
<td></td>
<td>Incentivize innovation in SMEs through collaboration with knowledge based institutions.</td>
<td>Issuer should be regional or national body making a commitment to pay the service provider (occasionally, to reimburse the SME the payment made)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grant ability to contract to foreign service providers across the EU or wider.</td>
</tr>
<tr>
<td>Technology Extension programs</td>
<td>Countries such as Bulgaria, by and large, are likely to benefit significantly from technology extension</td>
<td>Rigorous impact evaluations have shown that consulting and managerial training focus on technology extension can yield substantial improvements in firm performance.</td>
</tr>
<tr>
<td></td>
<td>SMEs are particularly constrained in scouting for technological know-how, and experimenting with new technologies.</td>
<td></td>
</tr>
</tbody>
</table>

17. The Sofia Tech Park, once completed, will provide the necessary infrastructure to house some of these innovation instruments. The tech park could go a long way toward improving interactions and collaboration between different actors in the innovation system. It would be an ideal place to house the accelerator and seed funds, a business incubator, a Proof of concept lab and an organization to coordinate Technology Transfer Offices (TTOs) in universities. For the successful development and operation of the tech park, it will be important to ensure that the instruments it houses are demand driven and that the private sector is adequately represented in its governance structure. With funding to complete the park and purchase laboratory equipment (€42.5 million from OP Competitiveness
and €7.5 million from the national budget) now secured, the tech park needs to focus on developing a plan for financial sustainability.

18. **Bulgaria through the JEREMIE program has introduced financial engineering instruments to support SMEs and innovative start-ups that have boosted early stage financing.** The guarantee facility and the risk sharing fund facility, both of which operate through commercial banks, has a growing portfolio that reached EUR 254 million as of June 2013, helping SMEs to secure approximately 3,700 loans. The initiative to channel EUR 21 million from OPC for acceleration and seed funding through two privately managed funds Eleven and LAUNCHub has shown promising results. As of June 2013, both programs have screened over 2,000 requests for funding from 30+ countries, and have made investments in 59 high-tech start-ups, using around EUR 4m of the available funds. This has led to business angel co-investments worth approximately EUR 400k that were secured by 3 of the start-ups that have demonstrated significant traction. Two new acceleration programs have been launched by private companies in Bulgaria inspired by the case developed on the ground by JEREMIE.

19. **Early stage investment funds in Bulgaria could assist in the identification of high potential start-ups and increase the pipeline for Venture Capital.** New enterprises, particularly those backed by venture capital, have proven to be a key engine for innovation. Whereas large firms often focus on existing clients and markets, new companies will often focus on exploiting new market opportunities. To attract venture capital, a company must have successfully developed the innovation, proved its technical capability, and identified probable commercial applications and markets. At that stage, venture capital provides the funds to expand production and develop those markets, and plays a critical role in supporting the later and most visible stages of commercialization.

20. **Although the equity instruments are showing first signs of success, it will be important to take account of lessons learned from earlier attempts by other governments to finance venture capital funds, many of which failed due to the lack of specialized knowledge of the sectors involved.** Several reviews of public venture capital programs globally⁶ point to the following lessons: (i) the fund should be a partnership between the state, as a passive investor, and a private venture capital source; (ii) the fund should require co-financing by the innovating firm; (iii) the fund should be flexible enough to accommodate changes in strategy; (iv) public venture funds have to be as disciplined as private funds about jettisoning underperforming companies after a trial period;(v) an international outlook is required to ensure that companies are globally competitive;(vi) careful and unbiased evaluation criteria would need to be adopted. It is important to support other financial engineering instruments that can play a significant

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role in financing innovation at later stages of the business life-cycle so that the funding sources don’t dry up as companies mature. Therefore the JEREMIE financial engineering instruments financing later stages are a welcome development.

**Governance: Developing a comprehensive framework**

21. **This chapter highlights the need for a stronger governance framework for the government’s innovation efforts.** The chapter analyzes the challenges of developing a sound governance structure for the innovation system, and proposes an institutional arrangement that would: (a) increase horizontal coordination between science and research with business innovation, within a policy agenda focused on creation of an innovation-driven economy; (b) bring innovation strategy and policy to the center of the national agenda; and (c) increase Bulgaria’s ability to make productive use of public financing instruments, including EU Structural Funds, in order to achieve that agenda.

22. **The fact that innovation policy in Bulgaria is designed and implemented by multiple ministries and agencies limits horizontal coherence in policy making and implementation and has negatively impacted the quality and rate of public expenditures on research and innovation.** The Ministry of Education and Science (MES) and the Ministry of Economy and Energy (MEE) are the main policymaking and executive bodies in the areas of science and technology and innovation policy, respectively. Their functions are complemented by several executive agencies and advisory bodies. Other ministries (primarily Agriculture, Health, and Defense) are formally responsible for research activities within their respective areas. The National Council on Innovation which is supposed to play an advisory role has not played a significant role in influencing innovation policy in Bulgaria as is typically the case with Advisory Councils without a strong mandate.

23. **Effective policy making in innovation is complex given the long term impact and systemic nature of innovation with significant risk of capture by stakeholders and therefore institutional development plays a key role in improving the quality of policies.** The challenge is to prevent two great dangers that typically weaken institutional governance: the natural tendency of governments to focus on policies with short-term benefits; and the equally natural propensity of the multiple agencies responsible for implementing policies to establish their own but uncoordinated agendas, responding to pressure from their constituencies, making the government support marginal, with limited effect in business behavior.

24. **Promoting the integration of science policy and technology development requires policies that respond to market signals and complement private sector willingness to invest in public goods, R&D, and human capital.** Countries use different models to organize state policymaking and coordination among different aspects of innovation (science and advanced education, research and technological development, economic and business innovation). Despite the different approaches, the national innovation systems in advanced nations all have some important elements in common, in that they: i) reduce fragmentation by consolidating agencies responsible for the main areas of innovation...
Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme “Development of the Competitiveness of the Bulgarian Economy” 2007-2013”, financed under Priority Axis 5 “Technical Assistance” of the Operational Programme, co-financed by the European Union through the European Regional Development Fund

(human capital, research, business innovation); ii) establish advisory councils made up of scientists, entrepreneurs, and policy experts, to provide specific knowledge and guidance to agencies and to help shape, update and discuss national innovation strategies with relevant stakeholders; iii) establish coordination councils at the ministerial level to ensure a coherent approach in prioritizing policies, allocating resources, and assigning clear responsibilities for detailed policy and instruments design; and iv) strengthen intermediary organizations to follow up and coordinate policy implementation in executing agencies. A cross-cutting challenge for all types of national innovation models is to incorporate assessment, evaluation and governance and accountability mechanisms into the work of the agencies, councils, and intermediate organizations. These mechanisms need to combine transparency, rigor, and timely, accessible information with independent evaluation of innovation policies and programs.

25. To develop a comprehensive governance framework to support and promote the national innovation agenda the government could establish a National Knowledge and Innovation Board (NKIB) to: i) coordinate policymaking across sectors, ii) monitor and evaluate the innovation policies and strategies of the different agencies and provide feedback for learning, and iii) ensure that issues considered in the regional strategies are taken into account in the national strategy. The Board should ideally be chaired by top level government representatives (at the Prime Minister or Deputy Prime Minister level) with the active participation of stakeholders including the ministers of relevant line ministries, academics, and business leaders.

Figure 0.3: Proposed Innovation Support System Institutional Arrangement

Proposed Structure of the NIB and Advisory Council

Note: The National Innovation Board (NIB) and the National Knowledge and Innovation Board (NKIB) refer to the same institution
26. An important role for the NKIB will be to assess the effectiveness and impact of the overall innovation system and individual interventions; and assess the performance of institutions and actors in the system. The NKIB will need to: i) set quality standards and a framework for evaluating individual institutions, programs, and actions; ii) ensure that evaluation mechanisms are embedded in the normal processes of the implementing agencies; iii) conduct thematic evaluations of progress in priority areas; iv) require evidence-based approaches to policy assessment and advice; and v) set performance indicators for services provided by the implementing agencies. Since some types of information are available only from decentralized entities, routine evaluation and analysis of bottlenecks should be embedded in innovation agencies, programs, and projects at all levels. Ensuring proper functioning of the system will depend on three levels of evaluation of: i) the overall innovation system; ii) individual interventions; and iii) the performance of institutions and actors in the system. Since it is difficult to measure the progress of initiatives with a long maturation period, the NKIB should establish intermediate indicators that indicate the direction and pace of change.

27. In line with international best practice, an autonomous Innovation Advisory Council consisting of stakeholders and experts should be set up to focus on long-term strategic issues and provide specific knowledge and guidance to the NKIB and at the strategic level with long-term perspective. The need for the Advisory Council is to reduce dynamic inconsistency and short-horizon planning through a process of consensus building to raise society’s awareness of the long-term benefits of research and innovation. The Advisory Council should monitor global trends in key technology areas, and conduct meta-evaluations of the country’s innovation system and processes, leading to policy learning. This institutional arrangement would allow the NKIB to play an effective coordination and policy role, while the Advisory Council would reduce fragmentation and ensure the continuity of strategic advice and intelligence. The design should guard against a situation where there is significant overlap between the Advisory Council and the NKIB –the clear differentiation of roles between strategic advice and intelligence from horizontal and vertical coordination and evaluation will help to prevent segmentation of the system. The Advisory Council responsibilities should be established by law, its members selected jointly by two different powers of the state (i.e. the Prime Minister and the President) and with overlapping tenure extending beyond the term of the government. The members of the Advisory Council should participate in the NKIB with right of voice for bringing strategic long term perspective into policy making and program design and providing feedback from stakeholders.

28. A stand-alone public Innovation Implementation Agency with a reasonable degree of autonomy will increase capacity and shield the national innovation system from changes in political circumstances. It is important to separate the policy-making roles of governments from the provision of public services, which goes well beyond the time-span of any particular government regime. The government should define the goals of the programs and the metrics upon which performance will be measured, while the agency should be responsible for detailed design and implementation. The implementing agency should also be the repository for expertise regarding the design of instruments for enacting the Smart Specialization Strategy. In addition to program design, the agency would also be responsible for: i) implementation of program including call for proposals, evaluations and award
decisions, and ii) providing regular feedback to the NKIB about what works and does not work, to inform future policy decisions. Unlike a policymaking agency, the implementation agency would accumulate expertise in detailed design of specific programs and instruments proposed by the ministries. The separation of implementation from policymaking will prevent excessive political influence on technical tasks. The positions in the agency should be filled based on merit only and not be linked to political considerations.

29. **It is critical to get the corporate governance of this agency right, in order to have transparent and efficient implementation and alignment with policy goals.** Most importantly, the agency should be subject to an overall Performance Contract Agreement for the creation of capabilities in the agency and improving the effectiveness in the allocation of EU funds. Furthermore each program should have a specific contract supporting the transfer of funds for specific programs with specific results indicators.

30. **The development of the Smart Specialization Strategy presents an excellent opportunity to launch the NKIB and the Innovation Advisory Council.** The Advisory Council could play a role in establishing a space for consultations to achieve consensus and stakeholder buy-in regarding the Strategy, which the NKIB could then formally approve once it was finalized. The NKIB could then coordinate the work of transforming the Strategy into an action plan with clear targets and responsibilities, while the Advisory Council undertakes studies to identify medium-term priorities for aligning science and research with business innovation.

31. **In the area of innovation, decentralization remains a controversial issue even for large countries.** The arguments in favor of decentralization are that regional governments may be better placed to identify opportunities and mobilize their knowledge bases because they are “close to the ground”. It also may promote a process of bottom-up self-discovery in a better way than national governments, or may promote a healthy competition among regions to stimulate aggregated innovation performance. Nevertheless, decentralization brings also many risks as wasteful duplications, fragmentation of public investments in R&D implemented separately and uncoordinated in different regions.

32. **Decentralization efforts should be focused on adjusting at the strategic level to the needs and vision of the regions and fostering regional outreach of instruments to promote business innovation.** The creation of Regional Innovation and Competitiveness Councils with the participation of regional authorities, local governments, business and academia could play an important role in promoting the regional agenda of innovation. The Councils should have the responsibility of defining competitiveness and innovation strategies and should have some executive capacities and promote competitiveness and technology road mapping in groups of companies or regional clusters.
Research: Developing a globally competitive and economically relevant research sector

33. This chapter assesses the challenges and opportunities facing Bulgaria’s research system, and recommends ways to strengthen the effectiveness and impact of that system as part of the Smart Specialization Strategy. With support from EC Structural Funds in the new Operational Programme “Science and Education for Smart Growth 2014-2020”, Bulgaria has an unparalleled opportunity to strengthen its research and science base. This chapter presents strategic long-term options for furthering that agenda, and also proposes pragmatic short and medium-term interventions to advance the Bulgarian research system. Comprehensive reforms in research funding and institutions should be promoted through Bulgaria’s Smart Specialization Strategy as a way to move the country toward becoming a more competitive knowledge-based and R&D-led economy.

34. Bulgaria’s inadequate research and knowledge infrastructure has led to a decline in scientific productivity and reversing this decline is a major policy challenge. A detailed benchmarking of Bulgaria’s research system suggests that the country’s scientific capacities have stagnated over the last twenty years, particularly when it comes to applied research and commercialization of research. The main findings are that: (a) Bulgaria’s pool of researchers has contracted over the last decade, in contrast with other Central and Eastern countries that joined the EU; (b) scientific productivity measured by publications and citations improved slightly between 2000 and 2010, but it still lags behind neighboring countries, the EU, and global leaders; (c) the research system is oriented towards basic research, with limited mission-oriented and applied research activities; (d) international collaborations with high-performing countries in the European Research Area (ERA) such as Germany, USA, France and Italy have increased, and about 50 percent of all publications are now produced with researchers from other countries; (e) commercialization of research is a major weakness of Bulgaria’s research system, with poor results across all standard indicators.

35. Increasing the effectiveness and impact of the research system requires new policies that address the imbalances in how the system is organized. The imbalances include: (a) a bias toward basic research; (b) weak synergies between research and teaching activities—the institutes of the Bulgarian Academy of Sciences focus mainly on research, whereas most universities lack a critical mass of research capacity; and (c) virtual absence of high-quality research outside Sofia, which inhibits other regions from developing knowledge-based economic activities. To resolve this, it would be important to commission a system-wide independent evaluation of public research organizations (PROs) and convene a high-level task force to agree on a roadmap to implement the recommendations. It is important to earmark budgetary resources to implement the restructuring of PROs and mitigate restructuring risks that have been observed in other ECA countries. The outcome of this restructuring process would be a leaner and more effective research system.

36. Allocating more funding to research could have a major economic and development impact, provided the right funding mechanisms are used. To maximize impact, future increases in institutional funding should be made conditional on the performance of public research organizations (PROs). Ideally,
the funding would be allocated on the basis of regular, independent monitoring and evaluation of each PRO’s performance; and by matching the resources that PROs can secure from external sources. In parallel to the reforms in institutional funding, it would be advisable to scale up and maintain a stable level of competitive project funding. Directing additional funds to collaborative research projects, with a strong emphasis on mission-oriented research in priority areas could have a major impact on the efficiency of public expenditures for science, and be a powerful incentive for high-quality research and collaboration. Finally, allocating substantial funding to top researchers based on a system that involves regular evaluations is critical to retaining talent and enhancing career development prospects.

37. **The National Science Fund (NSF) and its funding instruments need to be redesigned to better target high-impact research, particularly research that is collaborative and mission oriented.** New instruments are needed to channel substantial volumes of programmatic funding that, in the short term, build the capacity of existing research teams and facilitate the creation of public-private research consortia; and in the long term, lead to the creation of centers of excellence that have a strong position in European research. Introducing new models for sharing and acquisition of major scientific equipment would improve access among interested users and make possible a balanced sharing of the costs. In addition to reviewing the funding instruments, the delivery mechanisms for science funding need to be strengthened, as the NSF continues to be challenged by operational weaknesses and transparency problems.

38. **Introducing a merit-based funding program to retain top scientists and attract young researchers with clear potential would make research careers more attractive.** Many countries have developed a national system of research grants and stipends to individual scientists to mitigate the brain drain, stimulate scientific productivity, and strengthen incentives to pursue academic careers. Such grants typically provide financing for two or three years, and include resources for the main researcher, research assistants, and laboratory materials. This approach is more efficient than a generalized increase in academic salaries. To receive the grants, Bulgarian researchers should be required to participate in regular independent evaluations to assess their scientific achievements, knowledge transfer activities undertaken and the quality of their proposals.

39. **To foster greater R&D commercialization, policies that encourage Intellectual Property (IP) disclosure, IP monetization, and university-industry collaboration should be pursued.** Fostering the transfer, exploitation, and commercialization of research results is critical for Bulgaria’s research system to generate substantial economic impacts. Research commercialization depends on three main elements: (a) strong and deep relations between the research community and industry; (b) a research and innovation

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7 For example, each project would provide between €20,000 and €40,000 per year with a minimum of €10,000 as additional salary for the researcher. The resources are given to the researcher and the maximum overhead is usually capped at a low level, in the 8-15% range.
conducive IPR regime; and (c) appropriate incentives for commercialization of innovation. Existing support programs do not emphasize these key elements, which makes it difficult for Bulgaria to effectively capitalize on its research capabilities. Reinforcing the IPR protection ecosystem, strengthening commercialization of research and technology through Technology Transfer Offices, as well as improving cooperation between R&D institutions and business will require a combination of demand-pull and scientific-push approaches. Given the current size and organization of Bulgaria’s research system, a TTO consortium would be a good option for reinforcing commercialization activities.

40. The new Operational Program "Science and Education for Smart Growth 2014-2020" (OP SESG) presents a unique opportunity to initiate changes in Bulgaria’s science and research base. The new operational program is an important milestone toward revitalizing the under-funded Bulgarian science during the previous 2007 – 2013 programming period. The objectives and types of activities to be financed that have been proposed in the draft OP SESG are generally in line with the recommendations provided by this report.

Human Capital Formation: Developing advanced human capital and reversing the brain drain

41. This chapter addresses the need for skilled human capital to meet the demands of a knowledge economy. It provides an overview of the human capital challenges in Bulgaria and recommends ways to reverse the declining quality of higher education, the aging and shrinking of the population, the continuing brain drain, the lack of skilled labor, and regional inequalities.

42. Despite some reforms in the tertiary education system over the past two decades, higher education in Bulgaria continues to face challenges with regard to quality, efficiency, and accountability for results. In addition, Bulgaria has one of the most challenging demographic profiles in the EU and the world, with its population expected to decline by 27 percent between 2010 and 2060, ultimately decreasing to almost half of its level at the early days of transition. Bulgarian society is aging rapidly, with the population above working age expected to almost double its share of total population to 33 percent by 2060 compared to 2010. Most importantly, the population of age 15-24 years is also projected to decline by 41 percent between 2010 and 2060, which will have a direct impact on the tertiary education sector.

43. Reducing the convergence gap between Bulgaria and the rest of the EU will require sustained and marked improvements in productivity and a shift to economic activities with higher value-added potential, generated by employees with higher and better skills. Bulgaria’s Europe 2020 agenda and the related strategic documents adopted by the Bulgarian government (the National Reform Program and the Convergence Program) set the ambitious target of increasing the share of the people aged 30–34 with higher education to 36 percent by 2020. Developing the necessary advanced human capital and reversing the brain drain would require: i) making higher education more responsive to the
needs of industry; ii) expanding efforts to introduce accountability and improve quality of higher education by incentivizing institutional behavioral change; and iii) adopting a life-long learning system.

44. An integral piece of the government’s support should be focused on making higher education more responsive to the needs of industry. It will be important to undertake a specific assessment of human capital needs, and adjust the curriculum and develop programs to meet market demand. University/business collaboration efforts such as developing courses with industry input and offering scholarships in collaboration with industry should be encouraged. It is critical to develop a system for providing information on income and employability of different careers at the level of each HEI. Reliable information on existing and prospective career opportunities should be made available to graduates from the secondary and tertiary education. Furthermore, incentives for studying in technical and engineering specialties need to be introduced to steer students away from popular areas of study like economics and law where there are clear signs of oversupply.

45. The government should expand its efforts to introduce accountability into higher education financing, and consolidate the sector based on performance. Recent reform initiatives that have started to address some of these weaknesses include a major undertaking to collect information on educational outcomes and graduate employment in 2010 and 2011, as part of the Bulgarian Universities Ranking System (BURS)\(^8\) initiative. Establishment of performance-based contracts would align and strengthen linkages between the research capability development and graduate education programs as the third mission of the university. Furthermore, it is important to develop a quality assurance and accreditation program based on the development of a qualification framework.

\(^8\)http://rsvu.mon.bg

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46. **Over the medium to long term the government can make the vision to increase share of the people aged 30-34 with higher education to 36 percent by 2020 a reality by providing continued education for adults to acquire and upgrade the industry-specific skills.** The education and qualification paths should be diversified and high quality short-term (from several months to two year) training programs should be created for the different skill segments. Short-term training should generally build only special skills required in a specific industry and related to the use of a specific technology. The introduction of a system for validation of skills obtained outside of traditional schools or vocational programs e.g. programming skills.

**Monitoring & Evaluation: Effectively using M&E as a policy tool**

47. **This chapter underscores the importance of an evidence and results-based approach to innovation.** It is important to incorporate experimentation and learning from the M&E framework, create feedback loops from evaluation to program design and policymaking, and replace static monitoring indicators with more accurate impact evaluation methodologies. The chapter also provides a pragmatic framework to perform impact evaluation of smart specialization instruments such as (a) incubators and accelerators, (b) impact evaluation of vouchers and small matching grants.

48. **Monitoring and Evaluation (M&E) are important, complementary tools for tracking progress, determining the impact of interventions, and provide feedback to improve implemented policies and program design throughout the program cycle.** The design of the RIS3 should include clear, measurable objectives at the policy level and at all levels of implementation, as well as clear monitoring indicators that measure the change or evolution of the productive structure towards activities.
that are globally competitive and have a greater potential for value added. Output and outcome indicators should be designed to capture the extent to which a program creates additional investments – or may be crowding out private R&D investments. Furthermore, there should be indicators which capture differences in how innovation is promoted across regions and priority sectors.

49. **The first step in preparing an M&E framework is to conduct a needs assessment.** Before the decision on funding a policy is made, the feasibility and sustainability of the intervention must be evaluated. This evaluation could be based on case studies, summaries of existing research, lessons learnt from similar interventions in the country/sector to provide the empirical support for a suggested M&E of a development intervention.

50. **The M&E framework should be outcome based.** Designing such a framework involves three steps:

   - **Defining intervention objectives and the specific types of changes expected.** This process must include consultation and collaboration among all stakeholders to ensure that the right development priorities are identified. The stakeholders can define for policymakers what success would look like, and what intermediate outputs they would find acceptable. The consultation should continue stakeholders agree on realistic outputs and outcomes.

   - **Choosing indicators.** Simple and reliable indicators should be used to assess outputs and outcomes. These indicators should satisfy five criteria:
     - **Clear** - precise and unambiguous
     - **Relevant** – appropriate to the subject at hand
     - **Economic** – achievable at a reasonable cost
     - **Adequate** – sufficient to assess performance
     - **Monitorable** – subject to valuation by independent experts.

   These criteria, known collectively as CREAM, are in line with the recommendations of the Fifth Report on Economic, Social and Territorial Cohesion of the European Commission. The approach to selecting indicators should be minimalist (a small but representative set of indicators), conservative (based on experience, not hypothesis), and realistic (data availability constraints are acknowledged and taken into account).

   - **Measuring performance baselines and targets.** For each indicator, a pre-intervention baseline should be established. The outcome targets should be based on those indicators. A comparison of the targeted outcomes with the actual results will help evaluate the performance of the intervention and identify the underlying factors for the success or failure.

51. **Research and innovation strategies for smart specialization are integrated, place-based economic transformation agendas that respond to the development needs of a specific country or region.** One of the core properties of RIS3 is that they are evidence based and include sound monitoring and evaluation systems (European Commission 2012). For the Cohesion Policy, appropriate outcome
indicators must capture all the objectives of the smart specialization strategy, to ensure that all stakeholder incentives are correctly aligned, that progress can be effectively monitored, and that adjustments can be made where necessary. The central task, therefore, is to set clear and measurable objectives both at the overall strategy level and for each of its actions. Collectively, the outcome indicators for RIS3 should give a clear picture of the evolution of the regional productive structure towards activities that are globally competitive and have a greater potential for value added.

52. Policies to promote smart growth have to take account of how R&D and innovation manifest themselves in different regions and sectors. The interactions among R&D, innovation, and growth are location specific, and these contextual issues should be incorporated explicitly in the design of the Operational Program and associated projects. Setting sector and region specific results indicators will help revealing comparative advantages of these particular sector/regions and allow refining future policy interventions.

53. A review of the indicators in the OPC and the NRP called attention to the following issues:

i. Expanding the indicators would contribute to better measurement of progress. The Operational Program document provides many output indicators, but too few results indicators. The number of output and results indicators should be balanced. The indicator list has many indicators that are not closely linked with the results of specific interventions, which obscure monitoring and evaluation of procedures and assessment of their impact. For example, science and research infrastructure are crucial elements of the reform program, but the indicators merely measure the number of incubators, clusters, technology parks, and other sites, without reflecting the objective of the intervention. For such investments, measures of external R&D funds attracted to the incubator, or the intensity of cooperation between incubator residents and university or public research organizations compared to the regional average, or the number of spin-offs graduating from the incubator, would provide much for useful information.

ii. Indicators that capture additionality should be included in the M&E system. They should capture the extent to which the interventions create additional investments, or may be crowding out private R&D investment. Some results indicators of additionality are included in the list of proposed indicators for RIS3. For example, in research collaboration projects between PROs and the business sector, the indicator could be the amount of R&D funds generated by business sector; in research collaborations with foreign scientists/institutions, the indicator could be the amount of funds contributed by foreigners; or in publicly supported research projects, the indicator could be the number of projects accepted into Horizon 2020 programs.

iii. Indicators and their targets must be set at both program and procedure levels. Operational programs have many indicators that provide information useful for program monitoring. However, most of these indicators are set at the program’s priority axes levels, some of which are cover several procedures. These indicators need to be defined more narrowly at each procedure level, to help identify bottlenecks in the design and implementation at that stage in the process.
The number of products/processes/designs developed in each relevant procedure should be included in the indicators list. Moreover, periodical evaluation reports that address the additionality generated at each procedure level and priority axis level would be very informative.

**iv. Consolidate similar indicators when formulating the action plan.** For example, a variety of indicators on the utilization of a super-computing center, or on efforts to network in European markets through programs like EUREKA, EUROSTARS, or Enterprise Europe Network, could be a single indicator in the action plan.

**v. Include indicators that capture differences in how innovation is promoted across regions and priority sectors.** The current action plan for the National Reform Program (NRP) lacks any such indicators. Nor does the action plan make use of well-established human development indicators.

54. **Impact evaluation is more complex and expensive than monitoring, but it is the primary method for evaluating the actual impact of a strategy or program.** It is a worthwhile endeavor whenever a program is new, replicable, and untested and has the potential to yield results that will inform key policy decisions. Impact evaluations are particularly useful when they go beyond asking “what” the impact of the program was and focus on the “how,” testing out different mechanisms and program variations. Impact evaluation methodologies can be designed to fit the specific circumstances of each program. With the knowledge gained from impact evaluation, future iterations of each program can be made much more effective at encouraging innovation.

**Sectoral Case Studies**

55. **Bulgaria’s traditional manufacturing industries are facing strong price-based competition from China and the Far East, as well as quality-based competition from other EU countries.** Yet Bulgaria has emerging industries with strong growth and export potential, including pharmaceuticals and Information and Communication Technology (ICT). Both traditional and emerging industries could increase their productivity by building niche competitive advantages, a process which requires technology modernization as well as innovation. To flourish, these industries also need a favorable business environment and highly qualified human capital.

56. **This chapter illustrates the issues raised in the previous sections through the lens of key economic sectors which could significantly benefit from innovation and technology.** The case studies, based on extensive consultations with industry participants, government, think tanks and desk research, examine the existing strengths and weaknesses of the five sectors, reviews industry trends, and analyze the potential distortions generated by current economic policies. The findings from the case studies also inform the analysis in the report. While sectoral analysis allows for increased specificity in strategy development, it is also important for the strategy to allow for the emergence of new sectors that may not be immediately evident from an observation of market dynamics; and for specialization to emerge through market selection as a result of entry, exit, and experimentation.
57. The five sectors profiled in this report are food processing, machine building and electrical equipment, pharmaceuticals, Information and Communication Technology (ICT), and Cultural and Creative Industries. The selection of these sectors was discussed and agreed in advance with the government, and was driven by the following key criteria (Figure 0.5):

i. Targeted sector in Bulgaria 2020  
ii. Government research priorities  
iii. Export analysis  
iv. Scientific relevance of Bulgarian publications  
v. USPTO patents by Bulgarians  
vi. Employment generation

![Figure 0.5: Sector Selection Criteria](image)

58. The profiled sectors encounter both sector-specific and cross-cutting obstacles to realizing their innovation potential. Addressing these common problems will impact a number of industries, with a multiplying effect on economic growth. The table below presents a summary of the constraints that were identified, and we provide a summary of the findings of these case studies.

![Table 0.5: Constraints to Innovation](image)

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### Effective Management of Operational Programme “Development of the Competitiveness of the Bulgarian Economy” 2007-2013

<table>
<thead>
<tr>
<th>Sector</th>
<th>Issues</th>
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<tbody>
<tr>
<td>Mechatronics</td>
<td>- Insufficient supply chain</td>
</tr>
<tr>
<td></td>
<td>- Lack of collaboration between the business, university and research communities</td>
</tr>
<tr>
<td></td>
<td>- Energy inefficiency overcoming traditional costs advantages such as low labor costs, relatively low tax burden and proximity to markets in the Middle East and the Former Soviet Union</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>- Insufficient supply chain</td>
</tr>
<tr>
<td></td>
<td>- Lack of transparent regulation and procedures for early stage clinical trials</td>
</tr>
<tr>
<td>ICT</td>
<td>- Energy inefficiency overcoming traditional costs advantages such as low labor costs, relatively low tax burden and proximity to markets in the Middle East and the Former Soviet Union</td>
</tr>
<tr>
<td>Cultural and Creative Industries</td>
<td>- Insufficient supply chain</td>
</tr>
<tr>
<td></td>
<td>- Lack of transparent regulation and procedures for early stage clinical trials</td>
</tr>
<tr>
<td></td>
<td>- Energy inefficiency overcoming traditional costs advantages such as low labor costs, relatively low tax burden and proximity to markets in the Middle East and the Former Soviet Union</td>
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### I. Food Processing

59. The food processing sector has a significant share of the economy and accounts for the largest part of manufacturing in terms of employment and revenue.⁹ All segments of the food

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⁹Wine, poultry, fresh cheese and baked foods make up more than 60 percent of the processed food export (without tobacco). In 2011, there were 7170 firms operating in the sector, employing 114,222 people. Total revenue was EUR405 8942, equal to 5.1 percent of the Bulgarian economy. World Bank: Analysis of the Regional Context and Potential for Innovation in Selected Industries (2012)
processing sector are dominated by imports, with the greatest share in meat, poultry, fruits and vegetables, and organic products.

60. Bulgaria has a strong tradition of food research, with a well-developed education system, and many research organizations and universities with international linkages. The country has highly qualified researchers who engage in a significant level of outward migration (especially the younger ones), as well as increasing opportunities to participate in international programs in the food and health fields as a result of EU membership. Salaries of specialists in the education and research system are very low, which negatively impacts motivation and is one reason for the relocation of qualified personnel to larger urban centers and abroad. Furthermore, collaboration between research organizations and industry is weak, with ineffective exchange of information and limited interaction. In this context, it is imperative to bridge the gap between research and the market through targeted interventions.

Table 0.6: SWOT Analysis for the Bulgarian Food Processing

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
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<tbody>
<tr>
<td>- Strong tradition in food research, highly qualified researchers, excellent research organizations and established partnerships with food and health research institutions abroad.</td>
<td></td>
</tr>
<tr>
<td>- High standards for food quality and safety and</td>
<td>- Low level of R&amp;D and innovation intensity</td>
</tr>
<tr>
<td>- Well-developed transportation and distribution network</td>
<td>- Weak collaboration between businesses in the sector, universities and research institutions</td>
</tr>
<tr>
<td>- Low labor costs</td>
<td>- Outdated facilities and technologies resulting in high energy and water consumption</td>
</tr>
<tr>
<td>- Access to the EU Markets, tradition and presence in markets in Russia, CIS and the Middle East</td>
<td>- Inefficient supply chain due multiple intermediaries and</td>
</tr>
<tr>
<td></td>
<td>- Limited exchange of information between research organizations and industry</td>
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<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Access to EU market and traditions in markets in the Middle East and the CIS provide opportunities expansion and scale up</td>
<td>- Higher productivity in other EU Member States</td>
</tr>
<tr>
<td>- Increased demand for high-value added food products in both the export and domestic markets</td>
<td>- Strong depopulation of rural areas resulting in labor shortage in rural areas where processors are located</td>
</tr>
<tr>
<td>- Use of EU funds to invest in technological upgrading, logistics centers and marketing</td>
<td>- Increasing constraints in access to financing due to EU financial crisis</td>
</tr>
<tr>
<td></td>
<td>- Increasing raw material prices and equipment prices</td>
</tr>
</tbody>
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II. Pharmaceuticals

61. The Bulgarian pharmaceutical market is one of the smallest in the EU, but it has grown substantially over the past few years. The market reached 2,098 m. BGN (around 1,400 m. USD) in 2011, a 12 percent increase compared to 2010, and an 18 percent increase compared to 2009 (2012 IMS Health). Drug expenditure accounts for 2.45 percent of GDP$^{10}$, and the sector is expected to grow. Generic drugs accounted for more than 50 percent of sales in volume terms and more than 80 percent in value terms in 2011. The most important market is the pharmacy segment, which accounts for about 90 percent of the total. About 30 percent of the over-the-counter (OTC) market is for flu and cough medicine. Pharma exports have increased sharply over the past five years, and now account for 3 percent of Bulgaria’s overall exports.

62. The fast-growing pharmaceutical sector is characterized by relatively cost-efficient and high-quality production at a competitive price without a high level of R&D expenditures. The sector benefits from considerable investment by both Bulgarian and foreign producers, in boosting production capability and modernizing facilities to harness competitive advantage presented by strong traditions and geographic proximity to markets in the Middle East and the CIS. Actavis and Sopharma have developed substantial exports of generic drugs to Russia and CIS countries, which could signal a turning point for their regional competitiveness. The major importers of Bulgarian drugs are Russia (27 percent of total exports), Romania (11 percent), Croatia (8 percent), Ukraine (7 percent), Germany (6 percent) and Serbia (6 percent) as of 2011.

63. The sector has marked successes in the highly competitive generic drugs markets, especially at the regional level and in markets in the Middle East and the CIS. However, as the generic drugs market is facing significant competition from generics producers in Asia, the growth of the sector is dependent upon expanding into the higher-value added market segment: the development of new drugs and medical compounds, innovative medicinal delivery systems and techniques. All these areas are highly investment intensive and it is unlikely that the pharmaceutical businesses would enter these without targeted government support using EU funds.

$^{10}$The highest in EU with the exception of Greece.

$^{11}$Business Monitor International forecasts that the market will continue to grow in 2010-2013 at a compound annual rate of 9.1 percent.
Table 0.7: SWOT Analysis for the Bulgarian Pharmaceutical Industry

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Strong traditions in pharmaceutical research and drug production, good medical research base, highly qualified researchers</td>
<td>- Poor collaboration between pharmaceutical companies, medical research institutions and universities</td>
</tr>
<tr>
<td>- Local pharmaceutical companies with modern and EU compliant manufacturing facilities that are successful in exporting generic drugs</td>
<td>- National funding for research is limited and EU financial resources are not used effectively</td>
</tr>
<tr>
<td>- Potential for innovation and R&amp;D collaboration with international partners in new drug and medicinal compound production and associated early stage clinical trials leveraging the presence of multinational pharmaceutical companies</td>
<td>- Limited experience in R&amp;D associated with new drug development and early stage clinical trials activities</td>
</tr>
<tr>
<td>- High export volumes of generic drugs to markets in Western Europe, Russia and CIS and the Middle East</td>
<td>- Limited connectivity of Bulgarian research networks with European Research Platforms and insufficient knowledge and information exchange</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Exploring established markets for generic drugs in Western Europe, Russia and CIS and the Middle East for exports in the higher value-added market segment: new drugs, medical compound, medicinal ingredients delivery systems to markets</td>
<td>- Strong dependency on generic drugs - competition from Asian companies in the generics drugs segment could have negative impact on the sector</td>
</tr>
<tr>
<td>- Qualified researchers, well developed medical research base at hospitals is an opportunity to engage in all stages of clinical trials for developing new drugs, medicinal compounds and ingredients delivery systems</td>
<td>- Onerous business regulation/high barriers to entry of new generic products on the market</td>
</tr>
</tbody>
</table>

III. ICT

64. The ICT sector in Bulgaria is very vibrant and has shown consistent growth, even during the recent downturn. The sector has strong potential to spur innovation-based growth and promote service exports. It is divided in three key sub-segments: telecommunications\textsuperscript{12}, contributing 73 percent of all ICT revenues, computer programming accounts for 14 percent of revenues, information services (IS) consultancy correspondingly accounts for 6 percent of revenues. Since 2006 sector revenues have grown annually by 14 percent and its profits by 83 percent; while ICT goods and services exports have grown by a staggering 1,400 percent since 2005. Currently, ICT accounts for 47 percent of total business service

\textsuperscript{12}Mobiltel, Cosmo Bulgaria Mobile, and BTC are the three main telecom players, and account correspondingly for for 28, 20, and 6 percent of revenues.
exports\textsuperscript{13} with a value created per employee in 2010 averaging 45,700 BGN; three times higher than the national average for all industries (16,800 BGN per capita).

Table 0.8: SWOT Analysis for the Bulgarian ICT

<table>
<thead>
<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
</tr>
</thead>
</table>
| - High-value per employee outperforming most of the sectors  
- Good R&D potential, taking into account ICT patents and ICT projects under (FP7)  
- Active presence of top-multinational ICT companies, with local R&D and BPO centers  
- Rapidly increasing contributions of local companies in the highest value added market segments  
- Well-developed ICT infrastructure including high-speed broadband | - Below average R&D spending & ineffective spending of funds  
- Inefficient system for the protection of intellectual property rights, specifically service innovation and business process innovations  
- Shortage of labor combining technical knowledge with business and soft skill sets  
- Increasing brain drain due to relatively low salaries (from a global perspective) |

<table>
<thead>
<tr>
<th><strong>Opportunities</strong></th>
<th><strong>Threats</strong></th>
</tr>
</thead>
</table>
| - Small but growing domestic market, access to and presence in global markets  
- Upcoming e-Government initiative will spur further innovation and growth  
- Opportunity for technological absorption via FDI  
- Leveraging diaspora knowledge and networks can create opportunities for higher value added further development and global capacity  
- BPO, R&D and data centers growth opportunities are significant. ICT cluster could further develop outside Sofia  
- There are key areas where ICT capabilities in the country are highly competitive on a global level (semantics etc.) and could be a basis for “Centers of Excellence” development | - Dependence on foreign companies for patent development |

65. **The ICT sector has the greatest innovation intensity of all profiled sectors and the largest number of Bulgarian R&D projects financed under the EU’s Seventh Framework Programme (FP7).** The ICT sector accounts for 90 percent of all Bulgarian patents in USPTO for the period of 2001-2010, as well as the largest number of Bulgarian R&D projects financed under the EU’s FP7. Software,

\textsuperscript{13} Broadband Quality Score 2009 (BQS); Invest Bulgaria Factsheets, InvestBulgaria Agency, 2011

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hardware, telecommunication, and information services together account for almost 70 percent of Bulgaria’s international patents, and the number of patents has increased significantly since 2004. Data processing, digital processing, software development, digital communication, and electrical computers have the highest total number of patents.

66. **Bulgaria is recognized as a good destination for IT outsourcing and offshoring.**\(^\text{14}\) Key international players are already successfully operating a number of shared or managed ICT service centers. In addition to the R&D and business process outsourcing (BPO) centers operated by key multinationals, many of which have separate R&D units, there are also a large number of local SMEs.

67. **Nonetheless, Bulgaria’s ICT sector is still far behind that of other EU countries in its share of GDP and level of FDI.** It accounts for only about 5 percent of GDP, less than in Hungary and Slovakia, attracts less FDI than Romania and the Czech Republic. For ICT to become a leading driver of growth, a more forward-looking policy stance, as well as substantial targeted support, will be necessary.

### IV. Machinery building and electronics

68. **Bulgaria’s machine building sector has a heavy export orientation**\(^\text{15}\) **accounting for close to 15 percent of the country’s total exports.** More than half all sector production is exported\(^\text{16}\), a significant portion to fellow EU Member States Germany and Italy. This positive trend; however, creates a strong dependency on international markets for future growth and for this reason the sector is vulnerable to global as well as EU economic market trends.

69. **The sector has been severely impacted by the crisis in Europe, with employment decreasing from about 132,000 in 2008 to fewer than 114,000 at the end of 2009, on a continuing downward trend.** Another negative trend is the increasing age of sector employees, with the share of younger workers (under 24 years) falling from 5.4 to 4.6 percent – a loss of about 1500 young workers during that one-year period. Almost 55 percent of all employees are more than 45 years old. The declining number of engineering students and the lower quality of engineering education as a result of the crisis are becoming key issues for the sector.

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\(^{14}\)The country has been ranked the 9th most attractive location for offshoring of service activities such as IT, business processes, and call centers (A.T. Kearney, 2009) and as the 13th best destination for outsourcing (Economist Intelligence Unit, 2010).

\(^{15}\)According to the EU Cluster Observatory, the west-central and north-eastern regions of Bulgaria are among the top 20 regions for the manufacture of machines in the EU.

\(^{16}\) The biggest revenue producers are the electronics components and electric domestic appliance subsectors.

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70. **The sector has relatively low innovation intensity, with only seven patents granted between 2002 and 2012.** The main areas of innovation, based on these patents, are internal combustion engines and electrical generators. Local researchers have also produced an estimated 50 or more innovative products or processes that are still embedded in their respective projects and have not been patented.

71. **The sector is dominated by small players with insufficient level of value chain integration and collaboration among businesses.** This prevents larger scale projects and entry into higher value added market segments. For this reason, the sector would benefit from government support to replicate sustainable models of successful clusters, such as the electro mobiles and the hydraulics components clusters; as well as to ensure the sustainability of successful pilot projects. EU funding could be leveraged for the much needed upgrading of the technical infrastructure, as well as to spur R&D and to promote technology dissemination innovation through developing innovation-driven products and technologies.

### Table 0.9: Machine-Building and Electrical Equipment Sector SWOT Analysis

<table>
<thead>
<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
</tr>
</thead>
</table>
| - Strong export orientation and successes in markets in Western Europe, the Middle East and the CIS  
- Presence of successful international companies providing technology transfer and dissemination that can spur the next level of innovation-driven growth  
- Successful pilot clusters developing products in the highest value-added market segments, such as automotive components and electronics, electro mobiles, LED lighting, advanced hydraulics | - Ageing workforce  
- Declining number of students in engineering and devolving quality of engineering higher education  
- Low and ineffective R&D spending (as measured by the number of patents)  
- Engineering education in need of upgrading |

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17 Examples include energy saving LED-based technologies, advanced hydraulics components, electronics for the automotive industry, precision engineering equipment.
V. Cultural and Creative Industries

72. In Bulgaria, Cultural and Competitive Industries are capable to promote smart, sustainable and inclusive growth by fostering innovation spillovers. However, support for innovation in the country is almost exclusively directed to fostering research- and technology-driven innovation. While this is an important and crucial orientation, such an approach does not allow the country to take advantage of its full potential for innovation. Government support should be directed to promote all forms of knowledge and innovation, including sectors that drive innovation forward such as CCI sector.

Table 0.10: Cultural and Creative Industries Sector SWOT Analysis

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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</thead>
<tbody>
<tr>
<td>-Dynamically developing sector</td>
<td>-Poor enforcement of IPR rules</td>
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<tr>
<td>-Culture of recurring high-level of investment in new technologies and in increasing staff skills and capacities</td>
<td>-Lack of knowledge and skills in IPR management and</td>
</tr>
<tr>
<td>-Rich cultural heritage</td>
<td>-Shortage of creative talent and persons with creative entrepreneurial skills</td>
</tr>
<tr>
<td>-Vibrant domestic market and very high-level of internationalization</td>
<td>-Severely constrained access to finance for creative entrepreneurs and CCI businesses</td>
</tr>
<tr>
<td>-Access to the EU Markets, tradition and presence in markets in Russia, CIS and the Middle East</td>
<td>-Very poor awareness of EU funding opportunities and limited skill and capacities how to access these</td>
</tr>
<tr>
<td>Opportunities</td>
<td>Threats</td>
</tr>
<tr>
<td>-Increasing education on IPR management and creative entrepreneurship</td>
<td>-Unenforced IPR infringements and “stealing of ideas”</td>
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<tr>
<td></td>
<td>-CCI sector development bypasses the regulatory</td>
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</tbody>
</table>

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- Developing CCI business models promoting CCI and creative entrepreneurship
- Radically improve access to finance for CCI businesses and creative entrepreneurs, including through EU funds
- Promoting CCI clusters and establishing creative incubators and hubs

frame work governing the businesses
- Establishing monopolies and de facto cartels in certain CCI sectors
- Increasing “brain drain” due to uncompetitive compensation of creative talent and constraining creativity by favoring technical implementation CCI products/services

VI. Implementing the RIS3 at the sector level

73. Successful RIS3 implementation will require horizontal interventions and vertical interventions that build on the strengths of regional clusters. Table 0.11 highlights the opportunities for stimulating business innovation through horizontal and vertical instruments. Many types of innovation instruments need to be designed so that they meet the needs of specific sectors. For example, specialized business incubators could have a major impact in the ICT sector and CCIIs, but are less likely to succeed in machinery building or pharmaceuticals. Enhanced government coordination among line ministries, as well as between different levels of government, will also needed to take advantage of the opportunities that exist to increase Bulgaria's national and regional competitive advantages.

<table>
<thead>
<tr>
<th>Proposed S3 Business Innovation Instruments</th>
<th>Food Processing</th>
<th>Machinery Building and Electronics</th>
<th>Pharmaceutical</th>
<th>Information and Communication Technology (ICT)</th>
<th>Creative and Cultural Industries (CCI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Road-mapping</td>
<td>Technology Road-mapping</td>
<td>Technology Road-mapping</td>
<td>Technology Extension Programs</td>
<td>Business Incubators with Early Stage Financing</td>
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</tr>
<tr>
<td>Certification Laboratories and Experimental Fields/Food Processing Facilities</td>
<td>Technology Upgrading and Diffusion</td>
<td>Technology Upgrading and Diffusion</td>
<td>Competitive Matching Grants to for Business-Research Collaboration</td>
<td>CCI-tailored Matching Grants for Developing/Integrating Innovative Products, Processes, Marketing, and Organizational designs.</td>
<td></td>
</tr>
<tr>
<td>Competitive Matching Grants to for Business-Research Collaboration</td>
<td>Replicating Successful Clusters and Innovation Networks (Electro mobiles, Hydraulics, LED Technology)</td>
<td>Replicating Successful Clusters and Innovation Networks (Electro mobiles, Hydraulics, LED Technology)</td>
<td>Business Incubators with Early Stage Financing</td>
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</tr>
<tr>
<td>Integrating Clusters and Innovation Networks (proposed Agro Tech Park in Plovdiv)</td>
<td>Proof of Concept Labs</td>
<td>Technology Transfer Office consortium</td>
<td>Seed/Accelerator and VC Funding</td>
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<td></td>
<td>Focal point for innovation ecosystem through flagship innovation platforms: sector-specific Tech</td>
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<tr>
<td>Sectors</td>
<td>Food Processing</td>
<td>Machinery Building and Electronics</td>
<td>Pharmaceutical</td>
<td>Information and Communication Technology (ICT)</td>
<td>Creative and Cultural Industries (CCI)</td>
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<tr>
<td></td>
<td>Parks (Sofia Tech Park, Plovdiv Agro Tech Park), clusters and innovation networks</td>
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</tbody>
</table>

**Government Coordination – National and regional level**

| Ministry of Economy and Energy |
| Ministry of Education and Science |
| Ministry of Agriculture and Food |
| Ministry of Environment and Waters |
| Ministry of Labor and Social Policy |

| Ministry of Economy and Energy |
| Ministry of Education and Science |
| Ministry of Agriculture and Food |
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| Ministry of Economy and Energy |
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| Ministry of Agriculture and Food |
| Ministry of Environment and Waters |
| Ministry of Labor and Social Policy |

Integrated approach and alignment of policies on education and vocational training; scientific research and human capital formation; collaboration between business and research, technology upgrading and diffusion, promoting business-lead R&D; improving protection and enforcement of intellectual property rights and commercialization of research and innovations.

National-level coordination body with regional branches

Single governance body and speedier delivery of research and innovation support instruments.

**Regional Specialization**

| Varying degree of clustering, and regional distribution with highest concentration in the South West and South Central Regions (Sofia, Blagoevgrad, Sliven, Plovdiv, Stara Zagora) |
| Higher level of clustering with highest concentration in the North East, South East, North Central and South Central Regions (Varna, Shumen, Ruse, Gabrovo, Burgas, Sliven, Stara Zagora, Plovdiv) |
| Higher level of clustering with highest concentration in the South West, North Central and North East Regions (Sofia, Dupnitsa, Razgrad, Troyan, Varna) |
| Very high level of clustering concentrated in Sofia (over 85%) and some concentration in Plovdiv, Varna Ruse. |
| Very high level of clustering concentrated in Sofia and clusters in Plovdiv, Stara Zagora, Burgas and Ruse. |
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## C. Summary of Recommendations

<table>
<thead>
<tr>
<th>Area</th>
<th>Strategic Objective</th>
<th>Recommendations</th>
<th>Medium and Long-term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulating Business Innovation and Entrepreneurs</td>
<td>Create an environment that stimulates innovation, by addressing the need for:</td>
<td>Conduct industry specific technology road-mapping exercises to:</td>
<td>Revise IPR guidelines pertaining to:</td>
</tr>
<tr>
<td></td>
<td>• effective funding mechanisms (Operational Programs, national instruments, venture capital)</td>
<td>• identify the challenges of the industry</td>
<td>• government funded research</td>
</tr>
<tr>
<td></td>
<td>• stronger linkages between research and business</td>
<td>• forecast emerging market requirements</td>
<td>• joint public/private and academic/private research</td>
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<td></td>
<td>• well-designed IPR guidelines that facilitate uptake and increase the incentives to innovate</td>
<td>• pinpoint technology gaps and R&amp;D projects to help the sector become more competitive</td>
<td>• in-house firm research</td>
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<td>• a functional system for commercialization of technology</td>
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<td><strong>Establish technology extension programs to promote the absorption of global knowledge to improve the performance of industry</strong></td>
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<td><strong>Improve innovation funding instruments by:</strong></td>
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<td></td>
<td>• engaging specialized expertise for evaluating matching grants</td>
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<td>• simplifying and shortening the project evaluation procedures</td>
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<td>• expanding support for early stage investments and empowering the private sector to lead the venture capital funding process</td>
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<td>• strengthening monitoring and evaluation by having a richer set of indicators that balance outputs and outcomes</td>
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<td>• introducing impact evaluation to measure the additionality of different instruments</td>
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<td>• improving coordination with other ministries so that the results achieved are visible</td>
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<tr>
<td>Area</td>
<td>Strategic Objective</td>
<td>Recommendations</td>
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</tbody>
</table>
| Governance | Develop a comprehensive governance framework to support and promote the national innovation agenda | **Short-term**  
- including seed funds targeted to other sectors outside of ICT and cover the gap between the accelerator stage and venture capital  
  
*Ensure the instruments housed within the Sofia Tech Park are demand driven*  
- the private sector should be adequately represented in the governance structure  
- a sustainability plan for the Park should be developed  

**Medium and Long-term**  
- Develop and refine coordination mechanisms among governance agencies, sector ministries, research institutions, industry  
- Develop public participation mechanisms and reporting channels  
- Refine quality standards and M&E indicators based on learning and feedback  

*Establish a National Knowledge Innovation Board (NKIB) to:*  
- coordinate policymaking across sectors  
- monitor and evaluate innovation policies and strategies  
- ensure regional issues are taken into account  

*Establish an Advisory Council,* to:  
- focus on long-term strategic issues and  
- provide specific knowledge and guidance to the NKIB  

*Establish Regional Innovation and Competitiveness Councils in each region to:*  
- promote the regional agenda of innovation  
- define competitiveness and innovation strategies  
- promote competitiveness and technology road mapping in groups of companies or regional
<table>
<thead>
<tr>
<th>Area</th>
<th>Strategic Objective</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>Develop a globally competitive and economically relevant research system</td>
<td>Establish an Implementation Agency, to:</td>
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<td>- design and implement administration of instruments</td>
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<td>- provide regular feedback to the NKIB about what works and does not work, to inform future policy decisions</td>
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<td>Promote restructuring of the research system by:</td>
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<td>- commissioning a system-wide independent evaluation to assess and rank all PROs</td>
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<td>- convening a high-level task force to agree on a roadmap for restructuring research institutes and universities that would distribute research funds and human resources more equitably</td>
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<td>Improve the efficiency of public expenditures on research by:</td>
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<td>- making funding increases conditional on the performance of PROs, based on independent monitoring and evaluation.</td>
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<td>Redesign the scientific support instruments and strengthen the research infrastructure, in particular by:</td>
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<td>- establishing a collaborative research instrument (grants) combined with mission-oriented criteria</td>
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<td>- facilitating the creation of public-private</td>
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<td>- creating centers of excellence with a strong position in multidisciplinary and mission-oriented research aligning with the EU level</td>
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<td>- Initiate the restructuring of PROs taking into consideration the lessons learned from other countries in ECA</td>
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<td>- matching the resources that PROs secure from external sources to realign incentives</td>
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<td>- scaling up the volume of competitive project funding</td>
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<tr>
<td>Area</td>
<td>Strategic Objective</td>
<td>Recommendations</td>
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<tr>
<td>Human Capital Formation</td>
<td>Develop advanced human capital and reverse the brain drain by:</td>
<td>Short-term</td>
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<tr>
<td></td>
<td>• improving the higher education system</td>
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<td>• increasing synergies between research and teaching institutions</td>
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<td></td>
<td>• putting in place incentives to retain talent and reward excellence</td>
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<td>• facilitating participation in international communities of practice</td>
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<td>• addressing regional imbalances in education and research opportunities</td>
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<td>Make higher education more responsive to the needs of industry by:</td>
<td>Medium and Long-term</td>
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<tr>
<td></td>
<td>• adjusting the curriculum based on an assessment of the labor market</td>
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<td>• supporting cluster development</td>
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<td>• providing students with information on employment prospects</td>
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<td>Establish a national merit-based funding program to retain and attract top scientists and young researchers with clear potential based on regular independent evaluations</td>
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<td>Develop and implement a comprehensive set of policies that fosters IP disclosure, IP monetization, and university-industry collaboration to commercialize research by:</td>
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<td>• establishing a TTO consortium and strengthening the existing network of TTOs</td>
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</table>
### Monitoring and Evaluation

**Strategic Objective:** Use monitoring and evaluation as a policy tool to track performance, determine the impact of interventions, and provide feedback to improve implemented policies.

**Recommendations:**

**Short-term**

- Strengthen institutional capacity for M&E, and integrate M&E into every stage of the innovation process, from strategy design through implementation (measurement of intermediate outputs) and final evaluation of impact.

- Introduce an M&E framework to evaluate the performance of each implemented program and to enable evidence-based policy reforms.

- Develop an M&E framework with clear and measurable indicators for every program and intervention to:
  - require implementing agents to verify that activities are being carried out, funds are being used as intended, and outputs are evolving in the desired direction.
  - refine programs as necessary based on results.
  - provide guidance to independent experts in evaluating program outcomes to assess whether desired results have been achieved.
  - observe whether the implemented policies crowd in additional investments.

**Medium and Long-term**

- Develop a body of knowledge and guidance for practitioners based on learning from M&E.

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Project: BG161PO003-5.0.01-0003  “Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013”, financed under Priority Axis 5 "Technical Assistance" of the Operational Programme, co-financed by the European Union through the European Regional Development Fund.
Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013", financed under Priority Axis 5 "Technical Assistance" of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
Chapter 1. Introduction

1.1. Bulgaria’s innovation ecosystem is operating below its potential, whether measured by the system’s inputs (R&D spending) or outputs (number of patents, licenses, publications), or by the contribution of innovation to economic growth (value of high-tech exports). To advance Bulgaria’s competitiveness position and move up in the global and European rankings, there is a need for a new strategy that can make innovation a driver of exports, job creation, and growth. After years of healthy economic growth and job creation, the Bulgarian economy has entered difficult times. Innovation, as the engine of long-term economic development, can help Bulgaria to move up the value chain in industries in which it enjoys a comparative advantage as well as accelerate income convergence with the EU and achieve more inclusive growth.

1.2. Despite the adoption of a National Innovation Strategy in 2004, the EC OP Competitiveness 2007-2013 funding of €1.162 million to modernize Bulgaria’s economy, the development of a National Reform Program 2011-2015 (which set out concrete targets for increasing R&D from 0.6 percent of GDP in 2012 to 1.5 percent by 2020), and the preparation of regional innovation studies over the past decade, the performance of the national innovation system has been disappointing. Low R&D, in particular in the private enterprise sector, is a key reason for Bulgaria’s comparatively poor record when it comes to technology licensing and share of high-tech exports, patenting, and publications. But more important than the amount of R&D is its impact on the economy: R&D can only deliver the anticipated impact if relevant legislation, funding programs, and the capacity of the public administration are upgraded in tandem.

1.3. Under the Europe 2020 Strategy launched by the European Commission (EC), the Government of Bulgaria has committed to implementing new policies and increasing investments to strengthen Bulgaria’s innovative capacity and R&D intensity. The goal of this report is to support the government in developing a Smart Specialization Strategy that will facilitate the increase in R&D spending and economic impact; and in laying out its vision for smart growth through knowledge and innovation-based economic development. This report provides the inputs for the Research and Innovation Strategies for Smart Specialization through a comprehensive assessment of the governance structure, innovation facilitating instruments, and the key innovation assets – research and human capital. In keeping with the approach put forth by the EC, the report is based on broad consultations with members of the government, private sector, academia, and civil society. The report examines the main factors affecting the development of a vibrant and well-functioning national innovation system and concludes with case studies on four key sectors with the potential to benefit from an increase in innovation driven investment.

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A. The macroeconomic case for innovation

1.4. Over the last decade, the reallocation of productive resources and large FDI inflows in Bulgaria generated economic growth, but contributed little to upgrading skills and technological capacities. Prior to the crisis in 2008, growth had been driven by domestic demand. GDP grew by 6 percent a year between 2000 and 2008, much faster than in the previous decade. As in other EU10 countries, consumption contributed most to GDP growth during this period (Figure 1.1), fueled by rising wages and credit. Investment was financed by sizable capital flows from abroad, mostly in low-tech sectors and expanded from 18 percent of GDP in 2000 to 38 percent in 2008, supported by macroeconomic stability and prospects for higher returns following EU accession. Rising investment led to stronger domestic demand, which in turn had a positive effect on employment, with close to 600,000 new jobs created between 2000 and 2008, mostly in trade, transport, construction, and business services.

![Figure 1.1: EU10: Contribution to GDP Growth (2000-2008)](image)

Source: Eurostat and World Bank staff calculations

1.5. The economic crisis exposed longstanding weaknesses in the economy, notably the fact that low-skilled manufacturing, services, and construction sectors had been leading the generation of employment and economic growth. The crisis changed the growth model in Bulgaria, with net exports contributing most to GDP growth since 2009. Following the sharp drop in exports and industrial activity in 2009, exports rebounded and grew by double digits in 2010 and 2011, outpacing import growth rates as Bulgarian firms benefited from better terms of trade and stronger external demand from EU markets and Turkey. High-value products and services, however, remain a negligible part of exports. Domestic

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18 EU10 countries are the new EU member states: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.
demand has weakened significantly as labor and credit markets tightened. In 2011, unemployment reached double its 2008 level as sectors affected most by the economic downturn, such as construction and some services, underwent significant labor shedding. The end of the real estate boom and of easy access to credit brought a sharp decline in investment and further delayed economic recovery. Even the strong rebound of exports in 2010-2011 was not sufficient to give producers, investors, and lenders the confidence to boost investment.

1.6. In the face of intensified competition and much more difficult access to credit, firms were forced to enhance productivity mostly through job cuts. Gains in productivity have been higher in Bulgaria than in the rest of the EU10 since 2010 and concentrated mostly in the tradables sectors – industry, trade, transport, and tourism, and to a smaller extend in construction (Figure 1.3). However, this higher productivity was achieved mainly by cutting jobs, especially in construction, industry, trade, and transport. Gross value added in construction had in fact been declining since 2009 as asset prices and demand fell sharply. In contrast, the biggest productivity increases prior to the crisis were mainly in finance and insurance; arts, entertainment, and recreation; and ICT, mainly telecommunication, and were achieved in tandem with higher labor participation.
Bulgaria’s medium-term outlook is subject to a high level of uncertainty. Economic recovery has slowed in the EU, Bulgaria’s main trade and investment partner. In addition, the deceleration of economic activity in China, combined with anemic growth in the US, is negatively affecting external demand. Quarterly GDP data in Bulgaria confirm the slowing of economic growth, with GDP expected to fall to around 1 percent this year from 1.7 percent in 2011, and to remain modest in the medium term. Exports, which had been driving growth since 2009, have deteriorated since the beginning of 2012. Business sentiment and levels of orders have also worsened, especially in industry and construction. Recovery of investment is likely to be delayed further as economic growth prospects are dampened by high uncertainty in the EU. Consumption is slowly recovering, but lingering high unemployment and difficult access to credit are expected to moderate consumption growth going forward.

Research and innovation can help Bulgaria to move up the value chain in industries that enjoy a comparative advantage, and to increase its share of high-tech exports. This trend is reflected in Bulgaria’s export and technological performance and competitiveness rankings, as benchmarked against comparator countries. Reversing this trend will require a shift in approach and philosophy.

B. Evolution of the Bulgarian Innovation Institutional Framework

Bulgaria’s legislation on science, technology, and innovation has changed considerably since 1990, but only recently has it begun to move away from a science input-centric model towards one based on market outputs. Over the past two decades, Bulgaria has gradually developed an array of laws and regulations to support R&D and innovation. These measures have guided the establishment of public R&D and innovation organizations, outlined the framework for an innovation environment, and provided incentives for R&D and innovation activities. While there has not been a comprehensive cost-benefit or impact analysis of the national innovation system, the less than desirable results are self-evident. This report diagnoses why Bulgaria’s innovation ecosystem is operating below its potential in all three
important measures: inputs (R&D spending), outputs (patents, licensing, publications), and the contribution of innovation to economic growth (value of high-tech exports).

1.10. Bulgaria adopted the National Innovation Strategy (NIS) in 2004 with the aim of encouraging innovation, bridging the gap between research and industry, and increasing the competitiveness of the private sector. The NIS included financial measures such as the National Innovation Fund (NIF); as well as non-financial measures such as support for young specialists and entrepreneurs, development of technology centers, creation of clusters, incentivizing of foreign investment in R&D, and establishment of university entrepreneurship centers. Between 2005 and 2008, the NIF disbursed almost 17 million Euros to fund 369 such projects. However, the Fund was essentially inactive between 2008 and 2011 due to the crisis, funding only existing contracts. Similarly the National Science Fund (NSF) provided increasing volumes of competitive research funding until 2008, but the amount dropped sharply in recent years.

1.11. Bulgaria had gained access to a number of EU-level financial instruments for R&D and innovation support after EU accession in 2007, such as the Framework Program for Research, Technological Development and Demonstration, and the Competitiveness and Innovation Program. Bulgarian enterprises also gained access to the EU patent office and began to benefit from EU innovation incentives. By 2012, EU structural and cohesion funds had become the main source of public funds available for upgrading and modernizing Bulgaria’s economy. The National Strategic Reference Framework 2007-2013 (NSRF), adopted in March 2007 provides guidelines for the use of EU Structural Funds through seven Operational Programs (OP). With a budget of 1.162 million Euros, the objective of the OP for Developing the Competitiveness of the Bulgarian Economy (OP Competitiveness) is to support the ability of Bulgarian enterprises to compete internationally in the context of a global knowledge-based economy.

C. Regional Specialization

1.12. Bulgaria is traditionally highly centralized and has not developed a regional dimension to its research and innovation policy. All of the planning regions within Bulgaria created Regional Innovation Strategies (RIS) under the auspices of the EC’s “Innovating Regions in Europe” initiative. Bulgaria has six planning regions (2004-2008) – South-West, South-East, South-Central, North-East, North-West, and North-Central.19 Although the six regions demonstrated bottom-up activity in developing their RIS, these were not implemented due to lacking support from the central government, and there are limited

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19The pilot RIS for the South Central region was published in 2004; the RIS of the remaining five regions were published in 2008. More information at, ARC Fund’s publications: http://www.csd.bg/index.php?id=168&month=0&y=&pType=0&start=50&max=10
innovation policy measures implemented at the regional level. All innovation-related measures and support programs are coordinated at the central level.\textsuperscript{20}

**Figure 1.1: Regional sector distribution in Bulgaria (by number of employees, 2011)**

![Regional sector distribution in Bulgaria](image)

*Note:* The number of employees working in a region/sector is represented by full-time equivalents where available and by the total number of persons employed in other regions.


1.13. The research and innovation potential of the North West region is relatively low, underpinned by an insignificant number presence of distance learning centers of national universities and a good network of vocational training high schools. The prevalence of SMEs and micro firms with restricted capacity for purchasing and adapting innovations also affects the innovative performance of the region. The four research institutes in the region are in agri-food and focused on certain crops and agricultural practices - maize, vinery and winery, forages as well as animal breeding and agriculture. The region lacks general innovation suppliers, thus innovation partnerships are underdeveloped. No activities of priority sectors of the economy are available in the North West region (see Map above).

1.14. The research and innovation potential of the North Central Region is relatively high due to its hosting of five universities with national significance: D.A. Tsenov Academy of Economics in Svistov, Angel Kanchev Technical University in Ruse, Technical University in Gabrovo, and the St. Kiril and Metodii University of Humanitarian Sciences in Veliko Tarnovo. These also represent the research capacity and innovation suppliers for the region\(^2\). Applied research in agri-food is carried out in one research institute of the National Academy of Agricultural Sciences. Active organizations and structures in this regard are the Business Incubator in Gabrovo, the Business Support Centre for SMEs in Ruse (regional node of the Enterprise Europe Network) and the consortium High-Tech Park in Veliko Tarnovo. Agricultural production dominates in the North Central Region (See Map above). IT activities are present in Veliko Tarnovo, Razgrad and Pleven. Automobile industry is present near Lovech, involving Chinese investment for assembly of new cars.

1.15. The research and innovation potential of the North East Region is concentrated in the city of Varna. This city hosts five universities and schools of higher learning: Medical University, Technical University, University of Economics, Naval Academy and Varna Free University. Applied research in agriculture and fishery is carried out in three research institutes of the National Academy of Agricultural Sciences. Two institutes of the Bulgarian Academy of Sciences specialized in ocean studies and hydro- and aerodynamics and work closely with the Technical University and the Naval Academy in Varna.\(^2\) The analyses on the structure and operation of the regional innovation system show good links between research, academia and industry in certain fields, such as marine technologies and information and communication technologies. Active intermediary organizations are the Regional Agency for Entrepreneurship and Innovations - Varna with the launch of a Hi-Tech Park, the Business Incubator and Innovation and Technology Transfer Centre, Dobrich Chamber of Commerce and Industry (regional node of the Enterprise Europe Network in Bulgaria) and the JOBS network of business centers and incubators in small and remote municipalities. Agricultural production and IT service activities dominate among the priority sectors (see Map above).

\(^{21}\)Despite this concentration of research and academic organizations, the region has the lowest spending on R\&D - €3.6m, with gross expenditure on R\&D (GERD) of 0.13% of the regional gross domestic product (national GERD is 0.53%) in 2009. The largest contributor to GERD is the business sector, followed by the government and the higher education.

\(^{22}\)These contribute by €11,2m to national R\&D spending, with a gross expenditure on R\&D (GERD) of 0.3% of the regional GDP (national GERD: 0.53%) in 2009. The largest contributor to GERD is the public sector, followed by business and the higher education. According to Eurostat, in 2010 the region educated around 188,010 students. The leader in bibliometric indicators is the Medical University in Varna (with 738 citations and 183 articles for the period 2005-2009), followed by the Technical University in Varna. The human resources in science and technology (HRST) in the region are 27.5% of the active population, which is slightly lower than the 31.1% average value for Bulgaria for 2011 (Eurostat).
1.16. The South East region is not among the regional research and innovation leaders\(^\text{23}\); however, it has a significant concentration of researchers in the chemical and agricultural industries, and in the field of information technologies and energy efficiency with the University in Sliven.\(^\text{24}\) The region hosts over twenty research institutes, the most prominent being the petrochemical research institute in Burgas, the agriculture institute in Karnobat, and the livestock selection centers in Sliven. Agricultural and IT services activities dominate around the city of Yambol.

1.17. The research and innovation potential of the South Central region has been most adversely affected by transition from a planned to a market economy; the majority of sectoral institutes and enterprise research units were closed in the early 1990s. Research and innovation in the region\(^\text{25}\) is predominantly in the agricultural sector and the food processing and the region’s excellent regional research institutes and universities have the potential to become national centers of excellence.\(^\text{26}\) The premier research university in the region is the Plovdiv University "Paisii Hilendarski".\(^\text{27}\) Despite that employment in high-tech industries and knowledge-intensive services is lower than the national average\(^\text{28}\) and the region considerably lags behind the Southwest region, which has 5.5% of the total employment engaged in high-tech industries and knowledge-intensive services. The most advanced ICT hub in Bulgaria (after Sofia) is found in the city of Plovdiv. This region is dominated by agricultural production.

1.18. The Southwest region has the highest concentration of national research infrastructure and Bulgaria’s leading region in research and innovation. The capital of Bulgaria is based in the region, which hosts Bulgaria’s most prominent universities: Sofia University\(^\text{29}\), the Technical University, the University for National and World Economy, the New Bulgarian University, the Sofia Medical University, the Southwest University "Neofit Rilski", the American University in Blagoevgrad, Higher School of Insurance and Finance, etc., where 31% of all students in the country enrolled. (2010 Eurostat data). The region hosts many industrial associations, technology transfer offices and innovation centers, including the Center for Innovations at the Bulgarian Academy of Sciences, the GIS Transfer Centre; generates

\(^{23}\)The region generates 4.6% of all R&D expenditures or €7.7m (2009 Eurostat data). The gross domestic expenditures on research and development (GERD) are 0.18% of the total regional GDP; a rather low rate compared to the average 0.53% for the country and 0.89% for the Southwest region (2009 Eurostat data).

\(^{24}\)According to Scopus, Trakia University in Stara Zagora has the most citations and articles in the region for 2005-2009

\(^{25}\)According to 2008 NSI data, 8.5% of the total R&D personnel is situated in the South Central region.

\(^{26}\)According Eurostat data, R&D spending has increased in the South Central region from €2.5m in 2000 to €17.8m in 2008, or 10.7% of the total R&D spending in Bulgaria. This places the region second after the Southwest Region (in which 75.7% of Bulgaria’s R&D spending is concentrated). However, the data for 2009 shows decline. The region invested 0.21% of its GDP in R&D or €10.5m in 2009 (Eurostat data). The public sector provides over half of R&D expenditure in the region. In 2008 the region had 19.3% of all students in the country, thus taking second place after the Southwest planning region (Eurostat data).

\(^{27}\)The region accommodates 8.6% of the total R&D personnel and researchers in the country (Eurostat 2009).

\(^{28}\)For the region it is 2.3% of the total employment for the period 2000-2008, which is lower than the country average of 3.2%.

\(^{29}\)Sofia University had the largest number of citations and articles in the country for 2005-2009 (Scopus data).
75.7% of all R&D expenditures\(^\text{30}\) and has over half of the R&D personnel (64.3%) (2009 Eurostat). Employment in high-tech industries and knowledge-intensive services is higher the national average and the region ranks first in the share of the population with broadband access. The IT sector dominates among the priority sectors, which is evident from the map above.

### D. Digital Growth

1.19. Broadband has become a general purpose technology and an essential tool for the transition to a knowledge-based economy. The widespread availability of the broadband has caused ICT and the innovation eco-system to evolve and the innovation system to become much more open and inclusive. The adoption of fast and superfast broadband has accelerated this evolution providing many new opportunities for content, applications and platform providers who both compete and co-operate irrespective of their location.

1.20. There is a clear positive correlation between broadband penetration and the competitiveness of a country like Bulgaria where broadband penetration is low. There is a similar relationship between the proportion of citizens who are regular internet users and the proportion with good computer and internet skills. In turn, this skills factor links into the level of ICT professionals in the economy and has a negative impact on the take up of e-commerce, e-government, e-practices in general, and thereby affects the competitiveness prospects for all businesses. As a consequence Bulgaria risks becoming relatively less competitive and less attractive for citizens, businesses and investors.

1.21. Substantial progress has been made in the establishment of e-government services. The platform content and applications are in place. These services are widely used by businesses but only by a small fraction of citizens. However, there are interrelated impediments to the broadband enabled transformation such as low broadband take-up and rural broadband coverage, low participation in e-commerce and low levels of ICT and computer skills. More than 80% of Bulgarian businesses already interact on-line with government but only a very small fraction of them sell on-line. E-procurement and e-invoicing by government would provide a massive stimulus to e-commerce in Bulgaria.

1.22. Broadband has restricted use in Bulgaria, which feeds into the ICT eco-system in undesirable ways giving rise to low levels of computer/ICT/internet skills and ICT literacy. In many areas it is the responsibility of the private sector, particularly the large number of broadband operators, to take urgent

\(^{30}\)Total €147,4m (2009 Eurostat data). Gross domestic expenditure on research and development (GERD) is 0.89% of the region's GDP, a considerably high rate compared to the average 0.48% for the country (2009 Eurostat data). Most R&D expenditures in the region come from the public sector, with business R&D expenditure (BERD) being only 19.6% of the total GERD, compared to the 23.7% average for the country. The human resources in science and technology (HRST) in the region are 40.9% of the active population, which is significantly higher than the 31.1% average value for Bulgaria for 2011 (Eurostat).
action. It is for them to find paying customers, entice the ‘never used’ citizens, provide access to compelling content to stimulate ICT literacy and encourage SMEs to be active in e-commerce.

1.23. At the same time there are key roles of leadership, of coordination and action to be played by the Government of Bulgaria and its agencies. This is especially the case in those areas where only the government act – in establishing supporting legislation and legal instruments; determining the range and scale of e-government and ensure coordination between ministries and agencies, among others.

<table>
<thead>
<tr>
<th>Box 1.1: Digital Agenda for Europe (DAE) Scoreboard</th>
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<tr>
<td>In order to monitor progress the European Commission (EC) publishes a DAE Scoreboard measuring progress and other relevant metrics on a regular basis. A review of the data relating to the DAE scoreboard indicates that in Bulgaria:</td>
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<tr>
<td>• Broadband coverage is near the EU average and close to the DAE target</td>
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<tr>
<td>• Rural broadband coverage is below the EU average</td>
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<tr>
<td>• Next Generation Access broadband coverage is above the EU average</td>
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<tr>
<td>• Broadband penetration/take up is below the EU average</td>
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<td>• Data rates of the coverage are above EU average but below DAE targets</td>
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<tr>
<td>• SME participation in on-line markets is low</td>
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<tr>
<td>• The proportion of enterprise turnover from e-commerce is very low</td>
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<tr>
<td>• Citizen participation in on-line markets is low</td>
</tr>
<tr>
<td>• Half the population are regular internet uses</td>
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<tr>
<td>• More than 40% of citizens have never used the internet</td>
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<tr>
<td>• A low proportion of citizens are returning forms on-line to public authorities</td>
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<tr>
<td>• A high proportion of businesses interact with public authorities on-line</td>
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</table>

1.24. The need for access to broadband in rural areas is at least as great as the needs in urban areas but due to their lower population densities and disposable GDP per capita, the private sector does not respond and the needs of rural area go unmet. EU funds have been established to address this specific supply side market failure. These two priorities rural broadband access and e-procurement within e-government will provide the momentum for an acceleration of the transformation process. In terms of near term pipeline activities for harnessing digital growth a significant concentration of ICT professionals, in facilities like the Sofia Tech Park, and local branches of foreign high-tech companies in Bulgaria may invigorate the ICT labor market. This momentum would be enhanced if the concentration of ICT skills formed the core of a cluster of ICT and broadband enabled businesses.
E. Smart Specialization Strategy – the path to sustainable growth

1.25. The development of a Smart Specialization Strategy can serve as the impetus for the upgrading of the country’s research and innovation capabilities. The EC considers investing more in research, innovation and entrepreneurship as a crucial component for the future success of Europe. For Bulgaria (and other transition economies), this is even more crucial as the government contends with the impact of the severance of the long-standing relationship between research and business as the country moved away from central planning. As a result, the EC has decided that the submission of a Smart Specialization Strategy (see Box 1.2) should be an ex ante conditionality for access to Structural Funds in the 2014-20 period.

Box 1.2: What is Smart Specialization?

Smart Specialization is a strategic approach to economic development through targeted support to Research and Innovation (R&I). It will be the basis for Structural Fund investments in Research &Innovation as part of the future Cohesion Policy’s contribution to the Europe 2020 jobs and growth agenda. More generally, smart specialization involves a process of developing a vision, identifying competitive advantage, setting strategic priorities and making use of smart policies to maximize the knowledge-based development potential of any region, strong or weak, high-tech or low-tech.

Source: EC Smart Specialization Platform Website: http://s3platform.jrc.ec.europa.eu

1.26. The concept of Smart Specialization is “one where each region builds on its own strengths, to guide priority-setting in national and regional innovation strategies.” The objective of the Smart Specialization Strategy is to increase the impact and relevance of R&D through a fact-based consultative process that allows for “self-discovery” (David, Foray and Hall 2009). A smart specialization approach works with the industrial and economic grain of the country or region, using capabilities that have been developed over time to underpin its innovation potential. The challenge is that these capabilities are also highly specific, which can limit opportunities for entrepreneurs. That is why upgrading and diversifying those capacities are easier when countries move to nearby activities that exploit and redeploy existing assets. Smart specialization also justifies some degree of targeting to assist clusters that emerge in a largely neutral and competitive policy environment.

1.27. In line with EC guidelines, the report covers the following areas:

- Analysis of the context and potential for innovation: Chapter 2 (Stimulating Innovation and High-Impact Entrepreneurship) examines the dynamics of the entrepreneurial environment with an

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examination on the tools available to the government to meet the need of innovative entrepreneurs. Chapter 4 (Research) includes an in-depth assessment of Bulgaria’s research and innovation infrastructure and provides recommendations on how they can be upgraded. The linkage of the country’s researchers with the rest of the world (and Europe in particular) is also addressed at length in this chapter with recommendations on how to strengthen these linkages. Chapter 5 (Human Capital) addresses how the government can incentivize the universities to produce skills relevant for the innovative sectors of the economy.

- **Set up of a sound and inclusive governance structure**: The report shares the premise of the EC that stakeholders of different types and levels should participate extensively in its development of the innovation agenda. Chapter 3 (Governance) examines best practices across the world and provides specific recommendations on how best to govern the innovation system in Bulgaria.

- **Production of a shared vision about the future**: The EC proposes that countries should develop a comprehensive vision of the economy, society, and environment shared by all stakeholders. Chapter 2 introduces the concept of technology road-mapping, a collaborative process for developing common innovation goals. Engaging in this process will allow Bulgaria to develop a vision which is inclusive and therefore has a much higher chance of success.

- **Identification of priorities**: The objective of this report is to assist the government in identifying the areas of focus for stimulating innovation and accelerating the transformation of Bulgaria to a knowledge economy. By performing case studies on several key sectors in Bulgaria (Chapter 7 – Sectoral Analysis) the report provides the government with the context in which to set policy. Consolidating the governance mechanisms as described in Chapter 3 (Governance) ensures that the process is a coordinated one with all ministries and government bodies aligned and focused on the same priorities.

- **Definition of a coherent policy mix, roadmaps and action plan**: The report includes a candid assessment of the current policy mix and instruments used by the government to stimulate innovation; provides examples of best practices and stumbling blocks to avoid; and proposes changes to the current mix of instruments. Once the strategy is complete it will be important to engage all stakeholders in dialog in order to design a roadmap and action plan with a focus on ensuring successful implementation.

- **Integration of monitoring and evaluation mechanisms**: The EC lays emphasis on the importance of integrating mechanisms for monitoring and evaluating in the strategy and its different components (i.e. from the strategic overall objectives to the specific objectives of each of its actions) from the very beginning. Chapter 6 (Monitoring and Evaluations) describes in detail how the government should go about doing this and provides instructions on the design of a comprehensive M&E framework.
Chapter 2. Stimulating Innovation and High-Impact Entrepreneurship

A. Introduction

2.1. Innovative activities are carried out by entrepreneurs who exploit existing knowledge and technology to develop and disseminate new products and practices. An ecosystem that promotes entrepreneurship makes it possible to identify business opportunities and facilitates access to the inputs required for their development. The role of the government is to support this process by removing obstacles to entrepreneurial activity and providing the appropriate incentives and legal and regulatory framework.

2.2. A favorable business environment underpins competition, which in turn forces companies to improve their technological capabilities and skills and introduce efficient production processes, to engage in R&D to develop new products and services, to innovate. To create a favorable business environment the government needs to create an institutional base that establishes openness to trade; encourages and protects investment, including foreign direct investment; establishes and enforces intellectual property rights; and improves the ability of academic and research institutions to generate knowledge.

2.3. Even with a sound institutional framework, innovation is often hindered by market failures. Given the uncertain outcomes of innovation, firms are often reluctant to invest sufficiently in R&D. In Europe in particular, the fear of failure serves as a major hindrance to innovation, even though the knowledge generated by such efforts can have a high social value. As noted by the OECD, “the failure of … knowledge-based entrepreneurship does not imply that no value has been generated. Rather, ideas and new knowledge generated by failed firms and projects can be absorbed to the innovative activity fueling high-growth firms.” 32 For an environment in which failure has a business and social cost stigmatized, the government intervention in stimulating innovation and entrepreneurship is imperative.

2.4. The objective of this chapter is to outline how to effectively use the instruments at the government’s disposal to stimulate innovation and high-impact entrepreneurship. As examples of ineffective government intervention outweigh successful examples worldwide, this report will pay particular attention to potential stumbling blocks, to help guide the government’s efforts to develop effective intervention mechanisms. Of key importance for Bulgaria and other countries in the region—the first principle—is that the design of all instruments and mechanisms must ensure transparency and

accountability. As outlined in a recent report by the World Bank\textsuperscript{33}, given that corruption is one of the main constraints to the business environment in many ECA countries, it is of utmost importance that projects be protected from misappropriation by the state or state officials. A second key principle is that any instrument aimed at promoting innovation needs to avoid crowding out the private sector, by promoting private investment and risk sharing.

**B. An overview of entrepreneurship and innovation in Bulgaria**

2.5. In Bulgaria, as in the other European Member States, SMEs are of structural importance for the economy and are a key driver of economic growth. There were a total of 365,484 SMEs in Bulgaria in 2011, which is 0.2% fewer as compared to 2010. For the period 2008-2011, the number of enterprises increased by just over 27,000 (10%). The Bulgarian enterprise sector is dominated by microenterprises with fewer than 10 employees; these enterprises accounted for 91 percent of companies and employed 29 percent of the workforce in the years 2008-2010 (Box 2.1). 75.5% employees in the country work for an SME (defined by the EU as companies with fewer than 250 workers).

2.6. A study commissioned under the Seventh Framework program\textsuperscript{34} found that SMEs contribute 37.8 percent of total value added in the economy, and 31 percent in GDP. It also found that microenterprises spend the least on R&D and create the lowest levels of value added. While the high level of firm entry between 2004 and 2009 (7.09 new firms created per 1000 working adults, compared to the EU average of 4.86) could be an indication of dynamic entrepreneurship, the indicators on firm behavior reveal that Bulgarian SMEs are engaging in innovative activities at a much lower level than those in the rest of Europe (Figure 2.3).

2.7. The sectoral distribution of SMEs shows clearly a marked concentration of enterprises mainly in the retail trade sector. In the R&D field, where labor productivity stands closest to the average levels of labor productivity in the EU, the number of SMEs is three times smaller than that in countries such as Slovakia, Hungary, Austria and Denmark, where the size of the workforce is comparable to that in Bulgaria.


\textsuperscript{34}European Commission (2011), SMEs and stakeholders’ needs, requirements and feedback to overcome barriers for research & innovation activities in Bulgaria, edited by Todor Yalamov et al. MAPEER SME Project
Box 2.1: SMEs and E-Commerce State in Bulgaria

According to the Digital Agenda Scoreboard for Bulgaria, the proportion of enterprise turnover from e-commerce is very low. The Digital Agenda for Europe’s target is for 33% of SMEs to be selling online. Figure below presents limited data on the participation of SMEs buying and selling online for 2012, and on-line selling by Bulgarian SMEs (5.6%) appears to be in its infancy.

According to the Euromonitor International country report, although most online customers have their favorite online shopping outlets, there is no established leader in Bulgarian e-commerce. However, online payment systems have entered the Bulgarian market in the recent years (e.g. Epay.bg, eBG, PayPal among others), leading to an increase in domestic online transactions. It is likely that the limited participation of SMEs in Bulgarian e-commerce is the consequence of several interacting factors, including perceived lack of trust of citizens in online commercial transactions, and the limited computer skills and broadband penetration in rural areas. Demand for e-commerce services is constrained by the lack of trust, underdeveloped digital infrastructure and low broadband penetration in rural area high levels of citizens. Increased broadband coverage and digital literacy would open up a rural market allowing users and micro enterprises from rural areas to access the products and services that otherwise aren’t available. Such a step would also enable micro and small enterprises located in rural areas to increase their product and service offering in domestic urban markets and abroad.


Innovative Capacity of Bulgarian firms

2.8. SMEs face a number of obstacles to becoming innovative that negatively impact their potential for growth and, in many cases, their survival. A core objective of the Smart Specialization Strategy must therefore be to address these obstacles, to enable small companies with little impact on the economy to become high-impact innovators that actively develop new products and processes.
2.9. While the innovative capacity of Bulgarian firms has improved relative to the EU since the Operational Program Competitiveness was launched in 2007, following EU accession, the overall picture is still one of significant under-achievement. Bulgarian firms spent 0.3 percent of GDP on R&D, compared to 1.23 percent for all EU firms in 2007-2011; they ranked 71st out of 139 countries in productivity; and were 95th in business sophistication and innovation. Government support in the form of R&D spending during this period was only 0.29 percent, two-thirds less than the EU-27 average of

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36 Based on www.ec.europa.eu/eurostat
0.76 percent. The World Economic Forum Global Competitiveness report 2012-2013 placed Bulgaria 125th out of 144 countries in firm-level technology absorption (see Figure 2.8). Private R&D spending—or the lack of it—has a particularly strong effect on innovation. Studies have shown that the propensity of Bulgarian firms to innovate is positively and significantly correlated with their R&D spending and related investments in technological infrastructure; and that their output increases with their innovation efforts, whether or not the firm is new to the market.

Table 2.1: Bulgarian firms’ innovation performance relative to the EU-27 average, 2007-2011

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<tr>
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<th>2007</th>
<th>2011</th>
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<tr>
<td>Business R&amp;D expenditures</td>
<td>9.4%</td>
<td>24.4%</td>
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<tr>
<td>Public R&amp;D expenditures</td>
<td>58.5%</td>
<td>39.5%</td>
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Source: EC Innovation Union Scoreboard 2011; author’s calculations.

Figure 2.4: Technology Scorecard (selected indicators) for Bulgaria

Note: Ranking 1- best, 144 – worst.

2.10. The low technological content of Bulgarian exports is a strong indicator of the dearth of innovative activity in the private sector. A large share of exports consists of resource-intensive goods (oil and petroleum products, metal products, cereals) and labor-intensive goods (garments, furniture). The latter, in particular, are characterized by low innovation, leading to strong price competition from lower-

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cost countries and a declining market share for Bulgarian exports in several top industries (apparel, iron and steel). In general, Bulgaria’s export basket is driven by products below the world’s average level of technological sophistication. While Bulgaria still has a strong competitive advantage in mature resource-intensive industries (oil and petroleum products, cereals, minerals) that have well-established technological processes, Bulgaria can benefit from adaptation innovation in such industries by having stronger linkages with global innovation chain. In addition advances in computer science and engineering could be harnessed towards developing new commercial competencies in these areas. In the longer term, prospects for increasing export growth lie in industries with higher technological content (pharmaceuticals, chemicals), which depend on reliable funding for R&D.

2.11. In terms of patents (a traditional proxy for innovation), Bulgaria’s performance has improved in recent years, driven largely by increasing collaboration with Western scientists and R&D-intensive foreign investment. After a decline during the early transition period, there has been resurgence in patenting since 2007, with collaborative inventions, mainly with scientists and engineers in the USA, Western Europe, and Japan accounting for almost half of total patents issued in 2011 (see tables below).

![Figure 2.6: High-Tech Manufacturing Exports (% of total)](image)

**Figure 2.6: High-Tech Manufacturing Exports (% of total)**

![Figure 2.7: Evolution of EXPY](image)

**Figure 2.7: Evolution of EXPY**

Source: World Development Indicators

Source: Authors’ calculations, based on UN COMTRADE

<table>
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<th>Table 2.2: Patents granted by USPTO (per million inhabitants)</th>
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<th>Table 2.3: Patents granted by EPO (per million inhabitants)</th>
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<td>Country</td>
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<td>Bulgaria</td>
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<td>Croatia</td>
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C. Rationale for Government Intervention

2.12. This section of the chapter outlines the rationale for government intervention in stimulating business innovation. The argument is, in essence, that (i) appropriation failures which can lead to underinvestment require strong IP laws and increased incentives for R&D; (ii) coordination failures require vertical instruments, starting with a technology road-mapping exercise; and (iii) information asymmetries require specialized non-bank funding mechanisms such as matching funds and venture funding.

a) Appropriation externalities

2.13. Innovation is an example of a public good – i.e., the social returns from innovative activities tend to be higher than private returns, and therefore innovation is not performed at the optimal level for society. As outlined by Hausmann and Rodrik 2002, innovators do not have sufficient incentives to invest in innovation at a level that would be optimal because: (a) it this more effort than current production, (b) success is uncertain; and (iii) successes are quickly duplicated by other market players. A crucial component of the decision to invest in innovation, therefore, is the extent to which the firm can recuperate its investment, and realize a profit from its innovation efforts. The production of new knowledge generally entails high R&D costs, while the costs for copying or imitation are much lower. Further, technological innovation is typically based on knowledge, which can only partially be codified; therefore, it becomes mostly embedded in human capital and organizational routines, which is difficult to appropriate. In an open economy such as Bulgaria’s, the appropriation issue is even more serious, as it undercuts the incentive to invest in new activities and leads to significant underinvestment in research and innovation. In addition, the lack of an enabling environment and the difficulty of recouping the economic benefits of investment in innovation hamper the development of collaboration between firms and between firms and research institutions.

b) Coordination Failures

2.14. Many Governments around the world have discovered that solving appropriation failures is not sufficient to encourage the optimal level of innovation in an economy. As Fong (2000) points out, the
fact “that innovation policies are commonly regarded as necessary complements to patent regimes is an indication that the coordination problems inherent in self-discovery persist, and require systematic attention, even when problems of appropriation are addressed either by explicit policy or in the course of solving other problems.” The process of self-discovery (defined by Hausmann and Rodrik as “learning what one is good at producing”) is a complicated one that requires the active participation of all actors in the innovation system. Innovation, given its iterative nature, is usually not the result of an isolated action, but of multiple actors working in a highly interdependent system, where a failure of any of the actors impacts the success of the others. While some aspects of interdependency are essential for innovation, coordination failures can impede the development of emerging activities. Thus, unless there is a coordinated decision by different economic agents, the economic activity is not developed and the economy ends up in the low performance equilibrium. In such cases, the state could play a catalytic role in moving the economy to the high-performance equilibrium by providing a mechanism capable of responding to market signals, identifying relevant coordination failures, and coordinating with private sector actors to resolve them.

c) Information Asymmetries

Information Asymmetry underlies much of the lack of funding for commercialization of research. While pure (basic) research is globally recognized as a public good and is funded primarily by the public sector in most countries, and established products and processes are typically funded by the financial sector, products not yet commercialized tend to have neither public nor private financing, due to the risk that they will not be profitable in the short term, or could fail altogether. The fact that the commercialization process is very complex (involving prototype testing, product development, market research, government approvals, and more) exacerbates the situation. The result is often the so-called “valley-of-death” for innovative products.

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2.15. Figure 2.) in the absence of an active venture capital sector.
2.16. The intangible nature of technological innovation and the uncertainty regarding the economic results make it very difficult to finance R&D, as most banks (public or private) do not accept intangible assets as collateral. Charging high interest rates to compensate for the high proportion of failures leads to adverse selection and moral hazard issues which dampens demand from lower credit risk clients and increases the need for comprehensive monitoring. Credit markets try to address these issues by resorting to high collateral for granting loans and a preference for short term lending.\(^{40}\) Asymmetric information can also increase the market power of specialized finance institutions, as SMEs that are successful in gaining credit could become captive to a single financial agent due to the high cost and negative signaling effect of switching. A public bank dedicated to serving the SMEs sector could help to solve market power problems, but, as experience in many countries has shown, it does not by itself solve the main market imperfection affecting access to credit, i.e., the existence of adverse selection and moral hazard. In fact, these problems are often exacerbated by direct government intervention, due to political pressures and the difficulty of attracting competent executives.

D. Innovation-stimulating instruments

a) Intellectual Property Rights

2.17. An effective intellectual property rights regime increases the incentive to invest in R&D by removing the risk of rapid imitation, and ensuring ownership over the knowledge to the entity that created it. In addition, the public disclosure of IP innovations – particularly patents and utility models – plays a key role in the diffusion of new technological knowledge throughout society. Businesses also use IP rights to gain access to new markets (e.g., through licensing), establish strategic alliances, increase their bargaining power in negotiations with business partners or investors, and increase their market value in cases of merger or acquisition. Firms can also gain access to new financing opportunities through the securitization of IP assets.

2.18. Bulgarian legislation in the area of intellectual property protection is broadly in line with EU directives in all significant areas. Legislation on patent protection and registration of utility models is well developed and covers the key areas of new discoveries, scientific theories, and mathematical methods. The law puts no restrictions on the use of intellectual property for collateralization purposes, and the research sector is given broad discretion in managing their IP process. 41 Although these measures have reduced unlawful appropriation of IP, their implementation remains uneven, and they have failed to spur indigenous innovative activity.

2.19. Despite the sound regulatory framework, the IPR system in Bulgaria remains largely unused by entrepreneurs and academics, predominantly due to lack of awareness of the value of IP rights and the widespread perception that the enforcement of the law faces challenges. IP infringement remains a key concern of researchers which prevents them from applying for grants or patenting their ideas. Furthermore, obtaining IP is costly and cumbersome. Despite several measures by the Bulgaria Patent Office to make obtaining a patent simpler (including a special class of patents with simplified processing for SMEs), the perception that the IP system is a labyrinth still persists.

2.20. Because of real and perceived barriers in using the system, SMEs often use alternative means to protect their innovations, including secrecy, exploitation of lead-time advantages, moving rapidly up the learning curve, use of complementary sales and service capabilities, technical complexity, as well as ongoing innovation relationships based on trust and use of trademarks to differentiate their products from those of imitators. Even universities and public R&D institutes, which have the resources to produce

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41 For instance, at Sofia University, researchers are allowed to retain a third of the proceeds from their own inventions with a third going to the state and a third to the university. However, in the agribusiness area, all proceeds from commercialization of research by research institutes are the property of the government.
valuable intellectual property, lack the framework and experience to properly control and manage their innovations. Formal rules are, however, beginning to be adopted.

2.21. Government can increase the use of the IP system by enhancing awareness and knowledge of all of its elements – not only patents and utility models, but also trademarks, geographical indications, industrial designs, trade secrets, copyright and related rights, new varieties of plants, non-original databases, and rules against unfair competition. Effective approaches might include seminars, conferences, and campaigns on IP for entrepreneurs and SMEs; guides on various aspects of IP for entrepreneurs and SMEs; dissemination of case studies illustrating SME successes in leveraging IP assets; building IP content into customized training manuals for entrepreneurs and enterprises operating in specific sectors; articles on IP issues in business magazines targeting entrepreneurs, researchers, and SMEs; regular radio and/or television programs on issues relating to intellectual property and innovation; integrating IP issues into the training curricula and course materials for entrepreneurs, engineers, and business administration students.

2.22. Streamlining the IPR application process and reducing transaction costs would greatly facilitate the use by inventors, researchers, entrepreneurs and SMEs. Several countries inside and out of the EU have programs to streamline the IPR process which Bulgaria can replicate (see Box 2.2). The recent approval in January 2013 of an EU unitary patent system is a much welcomed development and should facilitate the IPR process in Bulgaria (See Box 2.3).

**Box 2.2: Facilitating IPR use – case studies**

Australia has launched an “Innovation Patent” with the aim of providing a “low-cost entry point into the intellectual property system.” Applications under the new innovation patent are less and of shorter duration – eight years. Shorter patent validity impacts cumulative and incremental innovation: basically using the patented innovation as the base for further innovation. Longer patent validity times raise the price of follow-on R&D and ultimately can discourage businesses from engaging in innovation activities and also the originator of the patent to make further advances in the area of the patent.

In Spain, to alleviate the financial burden relating to patent applications and to promote the protection of IP assets by Spanish enterprises abroad, different government institutions provide grants and subsidies to SMEs. Most of these grants form part of broader programs for the promotion of a particular economic sector or grants for helping companies to access foreign markets.

In France, the government trains and enhances the professionalization of IP commercialization departments in universities as well as business incubators to raise the level of awareness of researchers as well as creators of new businesses. Promoting interaction between universities, public R&D centers and SMEs in the field of innovation and technology transfer has also been the target of government and university programs. Institutions have adopted policies in terms of defining the ownership of IP rights, royalty-sharing mechanisms, how to resolve conflicts of interest and other similar issues that arise when public sector institutions and universities become involved in patenting their R&D results.
Box 2.3: The EU Unitary Patent Regime

In January 2013 the EU Parliament approved a new unitary patent regime which will provide automatic unitary patent protection in all 25 participating member states. The 'unitary patent package' consists of three elements: i) a Regulation creating a European patent with unitary effect (or 'unitary patent'); ii) a Regulation establishing a language regime applicable to the unitary patent; iii) an international agreement among Member States setting up a single and specialized patent jurisdiction (the 'Unified Patent Court').

Any inventor will be able to apply to the European Patent Organization (EPO), a non-EU body for an EU unitary patent valid in all 25 EU member states taking part. Patents will be made available in English, French and German. Applications will have to be made in English, German or French. The new regime reduces costs by requiring translation costs to be fully reimbursable for EU-based small and medium-sized enterprises, non-profit organizations, universities and public research organizations and renewal fees, which account for a large share of total costs, will be set at a level affordable by small firms. The EC expects EU patenting process to cost about €4,725, compared to an average of €36,000 needed today. The international agreement creating a Unified Patent court will enter into force on 1 January 2014 or after thirteen contracting states ratify it, provided that UK, France and Germany are among them. The other two acts would apply from 1 January 2014, or from the date when the international agreement enters into force, whichever is the latest.

2.23. IPR support in Bulgaria has focused mainly on patenting. However, the rise of service sectors such as ICT and creative services has increased the importance of copyright, trade secrets, and related rights. The traditional focus of the copyright system on artists, musicians, and writers has expanded in the current economic context to include the protection of software and multimedia. For the vast number of businesses operating in such industries, royalty revenues from the licensing of their copyrighted works is a significant source of income.

2.24. Collaboration between research and business in Bulgaria could be facilitated by incorporating the examples of the United States and some EU countries. In the US, the Bayh-Dole Act of 1980 gave universities the right to retain title to government-funded inventions, leading to the widespread development of university technology transfer offices (TTO), which provide patent and other commercialization support to scientists and researchers, and harness the ensuing revenue streams for the university. The Law created a national policy framework to encourage universities and other nonprofit organizations to collaborate with businesses on the commercialization of inventions and new technologies. As a result, research institutions began to devote more efforts to applied research and commercialization of that research, and many researchers formed companies to commercialize their own innovative and advanced scientific solutions.

42 After the Bayh-Dole Act, university TTOs helped researchers, and at times compelled them, to disclose their useful discoveries so that they may be patented. For further discussion see: Verspagen, Bart: “University Research, IPR and the European Innovations System” Eindhoven Centre for Innovation Studies, The Netherlands (2006).
2.25. Since passage of the Bayh-Dole Act, many EU member states have adopted similar frameworks to encourage the commercialization of research results. In Finland, Iceland, Italy, and Sweden, individual inventors (even if employed by universities or public research institutes) are entitled to privately own the patents that emerge from their research. In Austria, Belgium, Denmark, France, Germany, Ireland, Netherlands, Norway, Poland, Spain, the UK, and most other European countries, universities generally own the patents resulting from university-funded research. Importantly for Bulgaria and other new EU member states that aim to promote innovation, the European Commission does not claim the rights to any IP resulting from EU-financed research. The issues related to research commercialization are discussed further in Chapter 4.

b) Technology Road-Mapping

2.26. Bulgaria’s fragmented policymaking process in the areas of research, advanced human capital formation, technology development, and business innovation makes it poorly equipped to solve coordination failures. One methodology to begin the coordination failure identification process is technology road-mapping— a collaborative process among stakeholders to develop common innovation goals.

2.27. In the mid-1990s, technology road-mapping became a commonly used tool for strategic technology management. It was first used within companies (Motorola is often cited as its inventor), but was quickly adopted at the country level by the United States, Canada, Japan, the UK, and Australia. The process typically entails bringing stakeholders in a particular sector together to identify the challenges of the industry, forecast emerging market requirements, and pinpoint the technology gaps and R&D projects that would help the sector become more competitive. This can begin with a top-down process in which the government, with the help of independent experts, selects the key sectors to be analyzed based on their potential, within a regional context, to contribute to growth, exports, value added, employment, and innovation intensity. However, the optimal scenario is a bottom-up, decentralized process in which the government supports emerging sectors that self-identify and express interest in going through the process. Both approaches require active stakeholder engagement to be successful, with the government’s role limited to bringing important sector stakeholders together and facilitating discussions. The government would take an active role only toward the end of the process, as the policy implications of the discussions become clearer and the recommendations are transformed into programs and policy initiatives designed to meet the current and future needs of firms in that sector.

2.28. Extensive consultations during the preparation of this report revealed the willingness of the private sector and academia to engage in such an interactive process. This interest should be leveraged during consultations on the Smart Specialization Strategy. Experience has shown that combining top-down with bottom-up road-mapping approaches generates interest, but also competition, among different sectors in the prioritization of public goods to be provided by the state. Therefore, it is important to use independent facilitators to ensure the quality of the process and avoid the potential for capture by special interests, which is a significant challenge.
Box 2.4: Technology Road-mapping (TRM) – Case studies and lessons learned

USA
The United States Department of Energy (US DoE), engaged in a Technology Road Mapping process for the 2010-2020 time horizon with a specific policy goal – to help the nine most energy intensive sectors (identified as agriculture, aluminum, metal casing, mining, petroleum refining, chemicals, glass production, forest products and steel) to define common research priorities to reduce CO2 emissions. While the format of the exercise was mostly left to industry, the first step always consisted of the creation of a vision and a set of specific goals the industry sets for itself. Although these vision and goals may cover the full range of the industrial activities related to the sector, US DoE’s main interest lies in technologies for improvement of energy efficiency in, especially, industrial processes. At the end of a road mapping cycle, DoE makes research funding available for the technologies identified through the road mapping process. That is, technologies that are outside the map are excluded from co-funding by Government. Hence the technology Road Map provides the basis for negotiation within, first, industry itself, and, next, between industry and DoE. This road-mapping approach forced the industry to collaborate – a practice they had not historically engaged in.

Japan
The process of drafting a long term strategy on R&D needs in a given industry or technology field has traditionally been a highly co-operative process in Japan. This often involved large numbers of actors, including industry organizations, research academies and experts, and government agencies. However in the mid-1990s Japan engaged in a series of Technology Road Mapping exercises starting with the 1996 Photonics Technology Roadmap released by the Optical Industry and Technology Development Organization (OITDO) and expanding to several others covering chemicals, quantum information, geo-space engineering, electronics, space, green chemistry, inorganic materials, telecommunications, photonics, photovoltaics, semiconductors and steel among others. While the government did play an important role in initiating some of the cases analyzed, in other cases it was either industry organizations, or even technology committees at such organizations that initiated a roadmap exercise. In some cases, the initiative was also taken by an individual senior engineer on leave at an industry organization or by a high-level corporate manager.

Canada
Industry Canada (Canada’s Ministry of Industry) launched the Technology Road-mapping Initiative in 1995 as part of its strategic plan to support Canadian innovation. Technology roadmaps were prepared for covered include aerospace, aluminum production and products, electricity, forestry, geomatics, lumber and wood products, medical imaging, and metal casting, bio-pharmaceuticals, “intelligent buildings,” marine engineering, and photonics in collaboration with industry, academia and non-profits. A review of the program revealed that most of the technology roadmaps were mostly initiated by the government.

Benefits
TRMs show industries the importance of jointly developing R&D programs in a time where R&D funding (also inside companies) is scarce. They enhance knowledge exchange, collaboration and even the creation of more durable networks amongst industries, and between industries and academia, which is especially visible in sectors in which individual industries did not collaborate. They provide strategic vision not only for big firms but, very importantly, for SMEs.

Critical success factors
A review of technology road-mapping approaches globally revealed the following success factors:

Visioning and goal setting: Visioning and goal setting allows the industry, or more broadly the participants, to agree upon the future world that the industry is confronted to before going down in the technological details.

Process must be industry-led: It is important to have the process led by industry. The “hand-over” approach where the government transfers the exercise entirely to industry when it is finished, is interpreted as ownership by the administration with industry playing a secondary role and this typically leads to lack of buy-in by industry. The preferred approach is for the government to play the role of facilitator, take a back seat and only come back into the
picture when the road map is used by industry to obtain funding for the priorities that have been determined.

Creating high-level commitment upfront is crucial, i.e. before the exercise concretely starts. Involving decision-makers (within companies) throughout the process is essential especially when it is the first time that a road map is organized for a specific area or industrial sector.

Clear link to policy decisions: It should be clearly indicated how the results of the road mapping process will be integrated into the policy making processes. The objective should be to define the research priorities to be funded. Since a technology road map is a collective document and a shared proposal for research funding, if one single company would like to have its priorities on the road map, it will be obliged to convince the others that it should be there. This mechanism makes roadmap really a collectively supported document with not much room for individual power games – even it may be seen by some as lobbying, it will at least be a collective lobby instrument.

A sense of urgency: In order to mobilize actors to partake in a TRM exercise, there is the need to instill a sense of “urgency” in the participants.

Source: The Effectiveness of Technology Road Mapping- Building a Strategic Vision, Technopolis Group.

c) Innovation Funding Instruments

2.29. Access to credit is essential for SMEs. Research has shown that total factor productivity is positively affected by access to credit, a finding that has been validated for Bulgarian firms. An important reason for this strong association is that credit enables SMEs to access modern equipment, while the lack of access to credit forces them to do with low-cost, less productive technologies. Another reason is that in markets with a higher proportion of SMEs, access to credit has a higher impact on productivity, since it helps to reallocate resources from bigger companies with more resources but lower productivity, to smaller ones with more growth potential. Nevertheless, the risks of providing finance to SMEs – failure rates are high even in the US and other advanced economies (Table 2.4) – often outweigh the potential benefits.

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<th>Year</th>
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<td>Year 2</td>
<td>36 %</td>
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<td>Year 3</td>
<td>44 %</td>
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2.30. In industrialized countries, entrepreneurs tend to seek out “angel investors” (successful entrepreneurs seeking new opportunities) to support their early commercialization efforts before they are in the position to attract venture capital funding. In Bulgaria and the rest of ECA, however, the lack of such resources means that many promising innovations are not realized. Government can play an important role in filling in this gap by absorbing some of the asymmetric information risk that is inherent in the innovation process. When designing support programs, it is essential that government distinguish between existing firms and startups, which need to be supported with different instruments.

2.31. There is significant room for improvement and expansion of the innovation funding instruments currently employed by the government. The OPC uses matching grants extensively and while they are an effective vehicle to encourage firms to share and manage risk, their implementation is challenging (see Table 2.5). Designing matching funds to support innovation routines in existing firms is a fundamental first step toward the development of suitable market mechanisms. However, while there are significant benefits to matching grants—they align incentives and allow for specific targeting on a case by case basis—they are tremendously difficult to administer and require specialized expertise to evaluate. An in-depth examination of the OPC resulted in the following recommendations:

   a. Further institutional reforms are critical to improve policy design and implementation. Despite recent institutional changes, the OPC management structure calls for further reforms: (i) the institutional set up of OPC management is not in line with international good practices, which suggest that the development of an independent, stand-alone specialized agency is an effective way to manage public resources targeting innovation; (ii) the OPC Managing Authority (MA) lacks human capital with the right mix of experience, as well as understanding of innovation and the differences between science and innovation; (iii) there is a need to enhance the dialogue between the Ministry, the private sector, innovation infrastructure entities and academia on the country’s innovation

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These recommendations on improving the matching grants program are discussed in extensive detail in the World Bank report under the Bulgaria Advisory Services program “Supporting Innovation through OPC 2007-2013: A review and options to enhance results in the period 2014-2020.”
b. **Current project selection and evaluation processes have been a key factor hampering OPC implementation.** Although the OPC MA has introduced a number of measures facilitating OPC absorption, both financial and material implementation of the OPC innovation measures have been largely lagging. A key factor hampering OPC absorption is an inefficient project selection process which is complex, lengthy, lacks transparency, is not anonymous, and favors projects that comply with the procedure’s administrative criteria rather than project’s quality and innovative potential. Simplifying the process and introducing changes that would shorten the project evaluation is essential for effective implementation of innovation schemes and attracting prospective beneficiaries to apply.

c. **It is critical that project evaluators have significant technical and market expertise.** The technical project evaluation process does not involve a sufficient number of evaluators with adequate technical and commercial experience. It is strongly recommended that OPIC engages independent experts, including foreign peer-reviewers, with the right credentials to assess the merits of the idea. Such an approach would facilitate the evaluation process and guarantee the quality of the project assessment.

d. **The present procedures supporting business innovation could be further improved.** In order to enhance OPC absorption and attract a larger pipeline of innovation projects, it is recommended to reorient the focus on administering the program from one of risk aversion to one of risk management. The process will entail: (i) reducing the number of the eligibility criteria by selecting the most relevant ones in order to attract more applications; (ii) redesigning the scoring criteria so that the technical evaluation is performed by experts with adequate technical and market credentials; (iii) improving guidelines for applicants to enhance the quality of applications; (iv) expanding activities educating the applicants about preparation of the project applications; (v) providing clear guidelines for the applicants about the timeline and milestones of the application process, and (vi) developing a risk based review process where beneficiaries are audited on a sample basis and those who are found to be out of compliance with the requirements are heavily penalized.

e. **The new Operational Programme to be developed for the 2014-2020 cycle (OPIC) is an opportunity to introduce new innovation instruments targeting various stages of the innovation value chain.** The OPIC will most likely be the primary public source of innovation finance in the 2014-2020 perspective. In order to complement already existing innovation instruments and address existing gaps in supporting all stages of the innovation value chain, there is a menu of new instruments that would complete and boost Bulgaria’s national innovation system:

  i. **Business incubators which include early stage financing:** Studies on firm behavior show that Bulgarian SMEs are engaging in innovative activities at a much lower level than those in the rest of Europe. Bulgarian firms face a number of obstacles to becoming innovative that negatively impact their potential for growth and, in many cases, their survival. Among key issues is limited access to external sources of financing for innovative activities (e.g. for prototyping or pilot production), lack of success stories, lack of mentorship and hence lack of a culture of innovation. Business incubators/accelerators with early stage
investment funds, like ELEVEN and LAUNCHub in Sofia, which started operation in mid-2012, are well designed and their success is built on effectively enhancing the ability of start-ups to grow and survive. The ICT industry will continue to be in the focus of business incubators and accelerators in Bulgaria.

ii. **Proof of Concept Labs:** A key factor to increase the competitiveness of the Bulgarian economy is to empower individuals, communities and companies with the capacity to create new business, products and services. Proof of concept labs (PCL) can help Bulgaria at building this work force. These are workshops equipped with digital manufacturing tools that enable people to build almost anything, learn new skills (particularly in engineering and math), develop inventions, create new businesses, produce new personalized products, share their designs through the Internet and participate on a large network of community problem solving. This instrument is envisioned in the implementation plan of the Sofia Tech Park Innovation Flagship and the potential Plovdiv Agro-Tech Center Innovation Flagship.

iii. **Technology Transfer Office Network.** Bulgaria faces challenges in creating an ecosystem that fosters industry relevant innovation and technology commercialization. Although a number of TTOs have been developed during 2007 – 2013, they have limited capacity to effectively commercialize innovation. There is a need to aggregate demand and build on the strengths of the existing network. There is an urgent need to foster collaboration between business schools, industry and research community, and adopt programs that inculcate the importance of IP and innovation commercialization among the stakeholders. In that context, an effective network technology transfer office (TTO) is a critical body that, as a single point of contact connects the conceivers, generators, adopters, disseminators, and consumers of innovation. Such a network was established in May 2013, headed by the GIS Transfer Centre Foundation-Sofia, which united 23 TTOs from Bulgaria.

iv. **Matching Grants for R&D.** The business-science relationship is very weak in Bulgaria due to the transition period from a centrally planned to an open market economy. Moreover, among key problems for enterprises with regard to the innovation process and the management of scientific research is the lack of financing and the high costs for the implementation of innovative projects. Given the above, it is critical to foster engagement primarily of SMEs in research and innovation both through in-house R&D and research contracts. Matching grants, if implemented correctly could foster private sector R&D in Bulgaria.

v. **Diaspora Programs.** In the most recent WEF Global Competitiveness Report 2012-2013, Bulgaria ranks among the countries with the highest brain drain, 128th out of 144. Further, Eurostat data show that in the past 10 years, nearly 80 percent of Bulgarians with PhDs have gone to live or have remained abroad. Tackling this policy issue has an urgent priority for Bulgaria’s future, and tapping into Diaspora’s potential would be the first cornerstone for transferring the knowledge and skills back to Bulgaria, connecting to global knowledge.
networks, reversing the brain drain, advancing the scientific excellence and innovation capabilities as well as bridging the gap between researchers and industry. Matching grants could be promoted by the Ministry of Education and Science more strongly to foster collaboration between the private sector and Diaspora in R&D/innovation.

vi. **Innovation Voucher schemes** to incentivize innovation in SMEs through collaboration with the existing Knowledge Based Institutions (KBIs). Among common services used by enterprises are assistance with design, product development, inward technology transfer, innovation management, business process engineering, market studies, IPR, testing, certification. The Ministry of Economy and Energy have used this instrument in the past, which can be reinvigorated.

vii. **Technology Extension Programs.** The aim of such programs that improve the technological capabilities of existing industries and businesses by bridging the gap between knowledge stocks already available globally or nationally and local industries. Such programs thus focus on adoption and adaptation of technology and innovation that is not new to the world but may be new to the country or new to the industry. By reducing or eliminating information asymmetry between the industry that stands to benefit from adopting the technological know-how and the innovation and know-how already produced at a different location (a local university or research lab or firm in another country, for instance) such extension programs help improve the performance of the industry by helping the industry adapt and adopt the know-how.

Table 2.5: Proposed menu of innovation instruments

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Rationale</th>
<th>Best practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business incubators/Venture accelerator</td>
<td>- Identification of hi-tech startups and investment in innovative business ideas&lt;br&gt;- Facilitate knowledge diffusion and technological upgrading in low and medium-tech sectors</td>
<td>- Focus on picking the best ideas&lt;br&gt;- Use of incentives that will incubate high-growth businesses&lt;br&gt;- Strong involvement of universities&lt;br&gt;- Evaluation committee of business experts should make financing decisions</td>
</tr>
<tr>
<td>Proof of concept labs for prototyping and piloting</td>
<td>- Removes barriers such as start-up funding, access to equipment, and access to expertise</td>
<td>- Type of lab should be conditioned on private sector interest</td>
</tr>
<tr>
<td>Technology Transfer Office Network</td>
<td>- Optimization of technology transfer services in a cost-effective way&lt;br&gt;- In this model, the activities of TTOs will focus on: i) technology transfer promotion, ii) assessment of the demand for technology transfer, and iii) potential</td>
<td>- Having TTOs specialize in different areas to foster collaboration and contracting between TTOs</td>
</tr>
</tbody>
</table>
disclosures; while off-campus office is responsible for technical assistance in the process of knowledge commercialization.

| Diaspora collaboration program | For a country with a significant diaspora, this is an effective way for enhancing the transfer of the global stock of knowledge, which is critical for an economy innovation and competitiveness. | Initiatives promoting diaspora entrepreneurship have been developed across various countries and with different focus, e.g. research, networking mentoring, training and venture capital partnerships |
| Innovation Vouchers | Encouraging behavioral change in SMEs in traditional sectors towards innovation through technical assistance. Incentivize innovation in SMEs through collaboration with knowledge based institutions. | Simple application process Issuer should be regional or national body making a commitment to pay the service provider (occasionally, to reimburse the SME the payment made) Grant ability to contract to foreign service providers across the EU or wider. |
| Technology Extension programs | Countries such as Bulgaria, by and large, are likely to benefit significantly from technology extension SMEs are particularly constrained in scouting for technological know-how, and experimenting with new technologies. | Rigorous impact evaluations have shown that consulting and managerial training focus on technology extension can yield substantial improvements in firm performance. |

f. *Strengthening monitoring and evaluation in the OP*. A consolidation of mechanisms already introduced under OPC and new innovation instruments could boost Bulgaria’s innovation-based competitiveness. In parallel, it is important to strengthen the monitoring and evaluation in the OPIC. Options that exist include having a richer set of indicators that balance outputs and outcomes, introducing rigorous impact evaluation to measure the additionality of different instruments and improving the coordination with other ministries so that the results achieved are visible.
EU Structural and Cohesion Funds are the main source of public funds available for upgrading and modernizing Bulgaria’s economy. With a budget of EUR1.162 million, the objective of the OPC is to support the ability of Bulgarian enterprises to compete internationally in the context of a global knowledge-based economy. The OPC has two specific objectives: (i) encouraging innovation and increasing the efficiency of enterprises, and (ii) improving the business environment. OPC is implemented through five Priority Axes (PA), and the two related to direct matching grants were PA1, which focuses on supporting innovation, and PA2, which focuses on enterprise modernization.

As of September 2012, 2.53 percent of PA1 and 17.3 percent of PA2 had been disbursed to beneficiaries. The low absorption of the schemes under OPC PA1 is primarily due to: (i) the inability of the beneficiaries to secure projects co-financing, and (ii) the limited capacity of public authorities in managing and implementing the program.

Financial engineering instruments

2.32. Bulgaria through its JEREMIE program has used financial engineering instruments (a guarantee facility and a risk sharing facility) to support innovative starts up and SMEs. The loan portfolio of both instruments as of June 2013 was EUR 254 million for approximately 3,700 loans:

i. Guarantee Facility. The main objective of the instrument is to provide credit risk protection to the Financial Intermediaries translating into preferential conditions for the SMEs obtaining loans. Credit enhancement instruments are extremely flexible in terms of implementation and target beneficiaries and can be considered both as mass instruments as well as niche ones supporting certain priorities or sectors of the economy. Such instruments assume a great portion of the risk inherent in SMEs which banks would not consider to be fundable otherwise; usually those SMEs are micro and small companies with lack of sufficient financial history, insufficient collateral or management and bookkeeping standards suboptimal not adhering to the bank expectations.
2.33. Risk Sharing Funding Facility. This financial instrument is providing loans with preferential conditions to Micro, Small and Medium-sized Enterprises (SMEs) in order to reduce the particular difficulties that SMEs face in accessing finance resulting from the mismatch between interest rate levels requested from the finance providers and the ones businesses could afford to pay. The instrument could be implemented both as a mass instrument targeting all eligible SMS as well as be tailored to support priority economic sectors.

2.34. Other potential financial engineering instruments include:

i. Corporate Venturing is seen as a suitable method allowing for the smooth transfer of innovation created by entrepreneurs into business practices via the infrastructure and know-how possessed by corporations. It can be established with leading Bulgarian corporations to seek out innovative entrepreneurial companies with new technologies that are of strategic interest. Public funding could be matched on pari-passu basis with private funding provided by corporations for investments made through corporate venture funds into new technologies linked to the area of expertise of the corporation, thus facilitating knowledge transfer and interaction between innovations and businesses.

ii. Equity Co-investment Facility. The co-investment facility encourages direct equity investments into SMEs made by public funds in conjunction with other private investors on a deal-per-deal basis in all stages of the lifecycle of an enterprise. The co-investment ratio between public and private money can be either 50/50 or 70/30 depending on the stage, industry and the inherent risk of targeted enterprises.

2.35. Early stage investment funds in Bulgaria could assist in the identification of high potential start-ups and increase the pipeline for Venture Capital. New enterprises, particularly those backed by venture capital, have proven to be a key engine for innovation. Whereas large firms often focus on existing clients and markets, new companies will often focus on exploiting new market opportunities. To attract venture capital, a company must have successfully developed the innovation, proved its technical capability, and identified probable commercial applications and markets. At that stage, venture capital provides the funds to expand production and develop those markets, and plays a critical role in supporting the later and most visible stages of commercialization.
2.36. The recent EUR21 million acceleration and seed funding of privately managed funds Eleven and LAUNCHHub under the JEREMIE initiative using OPC funds is a most welcome development. Indeed, the JEREMIE model which outsources investment decisions to the private sector should be used for all financing that requires the evaluation of innovation potential of activities. As of June 2013, both programs have produced the following results:

- over 2,000 requests screened for funding from 30+ countries
- Investments have been made in 59 high-tech start-ups
- EUR 4m already called
- Business angel co-investments worth approximately EUR 400k are already secured for 3 of the start-ups that have demonstrated significant traction
- Participation in over 50 start-up events in Bulgaria and South-East Europe
- Two new acceleration programs were launched by private companies in Bulgaria inspired by the case EIF developed on the ground

2.37. Although the equity instruments are showing first signs of success, it will be important for the government to take account of lessons learned from earlier attempts by other governments to finance venture capital funds, many of which failed due to the lack of specialized knowledge of the sectors involved. Several reviews of public venture capital programs globally point to the following lessons: (i) the fund should be a partnership between the state, as a passive investor, and a private venture capital source; (ii) the fund should require co-financing by the innovating firm; (iii) the fund should be flexible enough to accommodate changes in strategy; (iv) public venture funds have to be as disciplined as private

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48OECD 2006.
funds about jettisoning underperforming companies after a trial period;(v) an international outlook is required to ensure that companies are globally competitive;(vi) careful and unbiased evaluation criteria must be adopted. The Israeli experience is a universally acknowledged example of a government’s successful attempt to develop a vibrant venture capital network. A grant program for medium-size non-innovative companies was developed in 1969 to support innovative efforts and encourage firms to incorporate innovation in their business strategy. Then in 1993, the Magnet matching grants program was started to encourage companies to form consortia with academic institutes to develop precompetitive, generic technologies. These two initiatives, together with the highly successful Yozma program (Box 2.6), set the stage for the culture of innovation and the robust venture capital industry that prevails in the country.

**Box 2.6: The Israeli Yozma Program**

The Yozma Program is one of the few universally celebrated publicly supported venture capital programs. In 1992, the government established the Yozma program and provided US$100 million divided among 10 private funds. Each fund manager raised a matching amount of private funding. The funds made investments of US$300,000–750,000 in hundreds of companies. By 1997, the government felt that it had achieved its goals and sold the Yozma Fund through privatization. From the beginning of the program the plan has been for the state to withdraw from the program after seven years. Private investors felt more confident knowing that the government’s involvement would be limited to a short period of time and that a specific exit date was already determined. The requirement to involve experienced foreign partners in the funds led to the recruitment of some of the most important venture capital investors worldwide. The local emerging high-tech industry benefited greatly from the image they provided and their vast experience and extensive international networks. The state representative on the boards of the funds refrained from interfering in the investment decisions to allow market-oriented decisions and only assured that the fund was acting according to regulations. This decision freed the funds from unnecessary bureaucracy and allowed them to operate according to the market’s needs. By participating in a privately managed venture capital fund, the government lends credibility to the fund and acts as a catalyst for other investors to participate.

*Source: Igniting Innovation, World Bank 2011*

**d) Facilitating coordination - Sofia Tech Park**

2.38. The proposed Sofia Tech Park could serve as the infrastructure vehicle to house all the coordination instruments outlined in Annex 1. It could also house a coordinating organization for the university TTOs. By giving the different actors in the innovation system a place to gather, the Sofia Tech Park could go a long way toward reducing the system’s many coordination failures. As with incubators, the focus should be on providing the tools, information, education, contacts, advice, and resources critical to success of the ecosystem. Cross-fertilization and value added are intangibles and difficult to create, maintain, and evaluate. For example, cultural barriers between industry and academia may be difficult to overcome. International partnerships also will be crucial to the success of the Sofia Tech Park, and it might be useful to provide incentives to attract FDI through creative forms of joint ventures, acquisition of foreign technology licenses, or turnkey projects.
2.39. Once in operation in 2015, the Sofia Tech Park has a chance to evolve into one of the hubs of Bulgaria’s innovation ecosystem by becoming a shared venue for networking, prototyping, research commercialization, and collaboration with national and international players, including Bulgarians living in the diaspora. To ensure the viability of Sofia Tech Park it will be crucial to include extensive private sector representation on the board and survey the private sector to ensure that the activities to be conducted in the Tech Park will be demand driven and therefore have a meaningful impact in improving the innovative capacity of enterprises. Going forward, the government should ensure that future Tech Parks are driven and financed by the private sector in collaboration with the other actors in the innovation system.
ANNEXES

Annex 1: Creating a Better Business Environment for Innovative Entrepreneurs

1. The Government of Bulgaria has made progress in implementing regulatory and administrative reforms to encourage innovation, but the regulatory burden and administrative costs of innovation continue to be higher in Bulgaria than in many EU countries. There are also pressing challenges related to developing needed infrastructure, improving resource efficiency, and strengthening public administration. According to Doing Business 2013, Bulgaria ranks 66th out of 185 countries in ease of doing business – ahead of Italy (73rd), Greece (78th), and Malta (102nd) – but it ranks 9th among the new EU10, behind all but Romania (72nd).

2. In 2007, Bulgaria was listed in Doing Business as a top reformer, based on extensive reforms in business registration as a result of the new Commercial Registry Act passed by Parliament in 2006. The Commercial Registry Act provided for structural, organizational, and technological changes in the business registration system; and transferred responsibility for business registration from the judicial branch to a new registration agency under the Ministry of Justice. The Registration Agency was also put in charge of the real estate registry and the national statistics registry (Bulstat), in order to enhance integration and data exchange between those registries. Registration officers were no longer judges, but rather clerks with the appropriate legal training. The reforms eventually resulted in the establishment and operation of an effective physical and online one-stop shop (OSS) for business registration. The new system, which was partially self-sustaining, reduced the time and cost of business registration and increased the rate at which new firms were established (Box A.1). Additional reforms in 2012 reduced the cost of business registration, which made starting a business easier. The country was also cited as a best practice example with respect to introducing simplified registration requirements, and its global ranking is high with respect to protecting minority investors.

3. However, Bulgaria has made little progress in several other areas of business regulation, including issuing construction permits, enforcing contracts, and requiring the payment of state fees. The fees regime is particularly burdensome for business due to an outdated legal framework, weak institutional structures, and the lack of a consistent policy. Concerns about the predictability and consistency of regulations are also higher in Bulgaria than in other new EU entrants.

Figure A.1: Bulgaria: Rank in Various Doing Business Indicators

A study on new firm registration in 91 countries (WB 2010) found that the costs, days and procedures required to start a business are important predictors of the number of new firm registrations. They also found important synergies with multiple reforms of two or more business environment indicators having a larger impact on business registrations. A review of the impact of the Bulgarian reforms shows that as expected, initial reductions in procedures for business registration helped to stimulate new business registration. However, as noted in the report as well, future reforms had a more limited effect (muted by the crisis) and therefore more targeted interventions are required as a next step.

A review of the impact of the reforms enacted relating to starting a business in Bulgaria between 2005 and 2010 shows the level of reforms:

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2010</th>
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</thead>
<tbody>
<tr>
<td>Procedures (number)</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Time (days)</td>
<td>32</td>
<td>18</td>
</tr>
<tr>
<td>Cost (% income per capita)</td>
<td>10.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Minimum Paid in capital (% income per capita)</td>
<td>81.6</td>
<td>20.7</td>
</tr>
</tbody>
</table>

As expected, initial reductions in procedures for business registration helped to stimulate new business registration; however future reforms had a more limited effect since they were muted by the crisis. More targeted interventions are required as a next step to promote entrepreneurship in Bulgaria.

Chapter 3. Governance

A. Introduction

3.1. During recent years, Bulgaria had difficulties in structuring innovation policies and implementing programs that could effectively foster total factor productivity based on business innovation. The challenges relate to lack of coherent implementation of programs financed from the European structural funds for period of 2007-2013, as well as the bias toward programs characterized by easy absorption of resources, limited additionally and impact in terms of innovation and long-term productivity. Fragmentation of ST&I sector has led to a lack of horizontal coordination among human capital, research and business innovation policies, restricting Bulgaria’s ability to attract and promote sophisticated investments in the country. In that context, strengthening institutions will play a critical role in taking advantage of the new Smart Specialization Strategy for 2014-2020 as well as Bulgaria’s transformation towards a more knowledge-based economy resulting in faster convergence with EU income per capita.

3.2. The objective of this chapter is to analyze the challenges of developing a sound governance structure for the Bulgarian National Innovation System and propose an institutional arrangement to accomplish several critical goals within the country’s innovation ecosystem. These goals are to:

i. Strengthen the capability of the State to develop and implement a long-term and consistent National Innovation Strategy that reflects society’s shared vision of the path to a more knowledge-based economy.

ii. Define a set of public policies consistent with the National Innovation Strategy that will enhance the innovation system.

iii. Ensure effective coordination among policymakers to promote innovation in all key sectors of the economy.

iv. Establish an implementing agency with a corporate governance structure to ensure accountability and coherence with innovation policy goals; as well as transparency and effective implementation of innovation programs.

v. Generate a culture of evaluation and continuous assessment aligned to strategic targets, policies, and the quality of implementation.

3.3. The ultimate goal is to place innovation policy and strategy at the center of the national agenda while increasing the impact of public financing instruments on fulfilling that agenda. The chapter first analyzes governance challenges of the Smart Specialization Strategy, identifying market and systemic failures in innovation, and most prevalent state failures in government interventions. Second, the chapter reviews alternative models of organizing the public innovation support system in the OECD countries. The third section examines Bulgaria’s innovation system and explains why institutional reform is necessary. Finally, we describe the characteristics of innovation implementation agencies, and the proposals for such an agency in Bulgaria.
B. Governance and Institutional Development in the Context of a Smart Specialization Strategy

3.4. Innovation is complex and systemic, involving many actors and long maturation periods. Innovation policy therefore requires horizontal, vertical, and temporal coherence to be effective. Achieving this coherence imposes important challenges, the first of which is achieving a national consensus that innovation is a right path to economic growth. Following that, the state must have a broad and long-term vision to guide the development of the innovation system through joint efforts of the public and private sectors, with business responsible for converting knowledge into innovation and wealth, and government responsible for creating an environment favorable for long-term investments. Government’s role includes developing governance institutions, proper incentives, and mechanisms to correct systemic and market failures that impede public and private efforts to help the country reach its full potential.

3.5. Economic progress may impose abusive behaviors among a variety of interest groups, including corporations, scientists, universities, entrepreneurs. These groups could aim to benefit from the state’s support and try to influence programs and legal regulations in order to obtain infra marginal benefits. To address these challenges a major institutional capacity building effort is needed to meet the requirements for full disbursement of the current European structural funds allocated to Bulgaria for 2007-2013 as well as to absorb and efficiently use EU resources for the years 2014 - 2020.

3.6. Sound institutional design is therefore of great importance for preventing failures that could lead to a misallocation of resources and undermine Bulgaria’s aim of achieving the goals of the smart specialization, which is critically important for Bulgaria to achieve convergence with EU development level by the end of the decade.

a) How to Prevent State Failures

3.7. State intervention in the design of innovation policies has three main weaknesses – dynamic inconsistency, capture problems, and agency problems. While failures may occur in any public policy, they can be particularly harmful in the case of innovation due to potential magnitude of the market failure effects.

Dynamic inconsistency, which may also be called temporal incoherence, relates to a public policy officials or government’s difficulty in enforcing a course of action when benefits may only be realized after their term will be over. Dynamic inconsistency is especially important because of the difficulty of measuring the impact of pro-innovation policies (
3.8. Table 3.1. Resolving this inconsistency involves two major challenges: first, balancing the tension between the private interests of short-term profitability versus the collective need for long-term performance; and second, developing awareness in society that creates the political incentives for maintaining public policy with long-maturing benefits. The political process will not solve these challenges unless proper institutions are established that maintain a long-term perspective in the phase of political changes. In the case of Bulgaria, the need to commit to the European Union regulations for the Structural Funds and Cohesion Fund, has in part solved the consistency issue.

3.9. Capture and rent seeking occur when a person or a group manages to extract a particular benefit from a public instrument; for example, persuading the state to finance activities that could have significant private returns without the need for public inputs. The danger of capture is higher in innovation precisely because market failures in this area are deeper, giving plenty of room for public intervention and for rent seeking by interest groups. The threat increases if, as in Bulgaria, the system is fragmented and compartmentalized, usually resulting in duplication and capture not only by the more advantaged stakeholders but also by executors of public policy (bureaucracies) that benefit from budget increases. As suggested below, one way to avoid these problems is a clear separation between those in government who formulate policies and those who implement policies, so that an adequate system of checks and balances, and a culture of evaluation and transparency can be established. This also requires institutional strength to cope with the pressures of interest groups, especially if power is highly concentrated in key institutions that make important decisions on financial resources. On the other hand, such a governance system has high inertia, which may delay the adjustment of instruments and priorities to market developments in an international environment that is continuously changing.

3.10. Agency problems arise because of information asymmetries in hierarchical relationships: a “principal” assigns a task to an executor agency; but the executor has different goals, and the principal lacks information on the executor’s actions and how they impact the outcome. This asymmetrical position undermines the principal’s ability to achieve its objectives. To minimize this problem, there are two types of instruments linked to principal-agency contracts: those that seek to diminish information gaps by increasing controls, and those that align the incentives of the executor with the policy goals of the principal.

b) The Challenge of Governance

3.11. The major difficulty in addressing innovation lies in its complexity, in the fact that it is a systemic, nonlinear phenomenon that depends on the confluence of many factors and actors and the relationships among them. The role of government in promoting smart specialization goes beyond just supporting the development and diffusion of new products, processes, and scientific advances. Government plays an equally important role in developing human capital and knowledge; in promoting organizational improvements, which are key inputs for innovation; in prioritizing research capability development; and in considering the human resource formation and knowledge needs of key sectors. The production of these inputs is slow and expensive, with uncertain results, and government must maintain a
balance between strategic investment in advancing scientific discovery and human capital formation in the long term, while simultaneously meeting business demand for innovative products and processes in the short term. Sector specificities and long lag times require effective coordination between these two critical pillars.

3.12. The design of public institutions to support innovation must account for all these complexities. The first design challenge is to address the systemic dimension of innovation, which requires clarity both in diagnosing the causes of systemic failures, and in setting the objectives and strategy for resolving them. This clarity should be reflected in the public institutions driving the system to ensure consistency and coordination among the various ministries, and state and regional agencies, many with very different cultures and objectives. This requires that the highest level of government has a sustained and visible commitment to public institutions for science, technology, and innovation (STI) to ensure a broad view, avoid commitment to particular interests, and maintain clear accountability for all actions and results of innovation policy.

3.13. The second challenge is institutional governance, to prevent two great dangers that always lurk: the natural tendency of governments to focus on policies with short-term benefits; and second, the equally natural propensity of the multiple agencies responsible for implementing policies to establish their own but uncoordinated agendas in response to pressure from their constituencies.

3.14. To address the threat of myopia and ensure that the long-term interests of society are well represented, state entities have been created to advise the executive and given a clear legal mandate. In international experience, entities with two different types of mandates have been created. Some entities play mainly an advisory role, focusing on long-term strategic innovation goals, global trends, and emerging technologies. Other entities may also have responsibility for long-term innovation policies, but their main role is to coordinate priority setting and implementation, and ensure consistent resource allocation. The advisory role is a quite distinct task from the formulation of detailed policy and implementation of specific programs, which correspond solely to the executive and specialized agencies. The coordination role should be led by the executive; nevertheless it is customary to have external independent members, "good men and women" who bring a long-term perspective.

3.15. It is also necessary to establish clear areas of responsibility for each of the multiple actors. Implementing agencies often lose responsibility for defining policies, while gain greater responsibility for inter-agency coordination, as in the case of development of the fish farming industry in Norway, or the salmon industry in Chile. In the coordinating role, the capacities of these agencies are strengthened, and their increased focus on developing intelligence enables contributing their specific knowledge to those who make policy decisions. This generally results in more effectively aligned programs, more complementarities, as well as reduced fragmentation and overlaps in program focus and resource allocation.

At the level of specific intervention, governments have the choice of various mechanisms to solve one or more types of government failures in innovation policy. The mechanisms fall into
three broad categories: (a) horizontal coherence and coordination to ensure a strategic, integrated focus on innovation across sectors; (b) vertical coherence to tackle agency problems and ensure follow-up and proper implementation of sector or ministerial action plans; and (c) temporal coherence to solve time consistency problems (}
3.16. Table 3.1).
Table 3.1: Coordination Tools and Coherence

<table>
<thead>
<tr>
<th>Coordination tools</th>
<th>Horizontal coherence</th>
<th>Vertical coherence</th>
<th>Temporal coherence</th>
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<tbody>
<tr>
<td>Policy frameworks</td>
<td>X</td>
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<td>Policy councils/platforms</td>
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<td>White Papers by Strategic</td>
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<td>Advisory Councils</td>
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<td>State budgets</td>
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<td>Government committees</td>
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<td>Task forces</td>
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<td>Informal networks and</td>
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<td>Negotiation</td>
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<td>Agency development</td>
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<td>Coordination with regions</td>
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<td>X</td>
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<tr>
<td>Performance contracts and</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>monitoring systems</td>
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<tr>
<td>Merging ministries</td>
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<tr>
<td>Joint programs</td>
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3.17. According to this framework, entities such as strategic advisory councils could play a role in horizontal coordination and temporal coherence, while policy councils and committees, together with the budget process, could be responsible for horizontal and vertical coordination. The latter could be enhanced by specialized implementation agencies with proper corporate governance. Finally, performance contracts and monitoring could help to address all three types of failures, in particular by allowing for vertical coherence and addressing agency problems.

C. Alternatives Models of Organizing the National Innovation Support System

3.18. Countries use different models to organize state policymaking and coordination for different aspects of innovation (science and advanced education, research and technological development, economic and business innovation). The models for organizing these aspects of innovation fall into three broad categories: (a) division of labor; (b) dominant player; and (c) separate pillars⁴⁹.

3.19. The design of a country's national innovation support system depends on the economic, cultural, political, and social conditions under which it evolved. Different countries have different structures for innovation support.

a) Division of Labor Model

3.20. Several countries use some type of division of labor model. In Germany, Norway, Finland, Chile, and the Netherlands, the division is between a science and human capital pillar on the one hand and a business innovation and technology pillar on the other hand. Other ways to describe the division of labor approach is to separate from the perspective of a supply and capacity-driven and a business demand-driven policy and implementation. For example, Germany and Norway have both a powerful Ministry of Science and a powerful Ministry of Economic Affairs. Their responsibilities are completely separate, they operate independently, and each ministry uses its own policy implementation agencies.

b) Dominant Player Model

3.21. The dominant player model is characterized by an organization that is largely responsible for chain of innovative policies. At the policy level, this model can be effective in promoting the integration of science and technology policies with economic development and trade policies. This model is used by Ireland, Sweden, and the UK.

3.22. The existence of a dominant player at the policy level allows coordination from a single government department; however, implementation must still be coordinated by different agencies, which can often be highly complex. One shortcoming of this model is that the central department may not have the depth of knowledge needed to guide or monitor each agency's work. To address this shortcoming, some countries have established organizations specifically dedicated to coordination, such as Forfas in Ireland, which coordinates and advises the various implementing agencies, yet is not responsible for policy decisions.

c) Pillars Model

3.23. This model depends on government organizations that specialize in or represent specific areas of innovation: science, technology, information and communication, economic and trade development, and so on. Each organization implements policies in its particular area and through its own agencies. The result is a highly specialized but fragmented system in which inefficiencies may arise – e.g., duplication of activities without economies of scope. While it is possible for government to define specific strategies and target specific areas of innovation, this fragmented structure has a high efficiency cost. Korea is an example of a country with a pillar model.

3.24. Despite these different approaches, the National Innovation Systems in advanced nations have some common important elements. They all seek to:

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- **Reduce fragmentation** by consolidating agencies responsible for the main areas of innovation (human capital, research, business innovation), in order to increase critical mass, increase the impact of public policies and limit competition for resources among agencies.

- **Strengthen or create advisory councils** made up of scientists, entrepreneurs, and policy experts, to provide specific knowledge and guidance to agencies in line with national innovation strategies.

- **Strengthen or create a coordination council** to ensure a coherent approach in prioritizing policies, allocating resources, and assigning clear responsibilities for detailed policy and instruments design.

- **Strengthen intermediary organizations** to follow up and coordinate policy implementation in executing agencies. These new intermediate organizational arrangements, so called interlocking directories are dedicated to setting and monitoring policy implementation, which, along with other actions, help meet the principle of accountability.

3.25. A cross-cutting challenge for all types of national innovation models is to incorporate assessment, evaluation and governance and accountability mechanisms into the work of the agencies, councils, and intermediate organizations. These mechanisms need to combine transparency, rigor, and timely, accessible information with independent evaluation of innovation policies and programs. The mechanisms should also allow for obtaining regular feedback and learning over time.

3.26. Councils and agencies with proper governance structures play an important role in solving horizontal, vertical, and temporal coherence challenges. These issues are discussed in greater detail below.

**D. Why institutional reform of the Bulgarian innovation support system?**

a) **Governance of Bulgaria’s Innovation Support System**

3.27. Innovation policy in Bulgaria follows the division of labor model; it is designed and implemented by multiple ministries and agencies, and is characterized by the fragmentation and coordination problems of that model. Among others, it has negatively affected the quality and rate of public expenditures on research and innovation. The almost complete separation of STI policies from the needs of business and the productive sectors limits the innovative outcome of the country. In other words, with the current fragmentation of the system, Bulgaria is unable to develop a coherent approach to create the capacities for commercialization of innovation. Going forward, the quality and growth potential of entrepreneurship will depend on connecting the science and technology base of the country with entrepreneurial development. The possibility of transferring, adapting, and diffusing technology depends on the existence of technology institutes that have clearly established these goals, rather than focusing on basic science in competition with universities and PROs. The institutional fragmentation in the public sector limits horizontal coherence in policymaking and implementation. The political cycle and the problems with execution of existing programs, in particular those financed by the EU structural funds, reduce temporal coherence, which prevents institutional development and the creation of capabilities in the public sector.
Finally, achieving vertical coherence and speedy execution have been promoted in Bulgaria by recent incorporation of the Agency in charge of SMEs’ development into the Ministry of the Economy, Energy and Tourism. Such change will result in reduced effectiveness, transparency and accountability.

### Box 3.1: Use of Public Funds for Innovation

Most research programs are formulated by the Ministry of Education and Tourism and are implemented by the National Science Fund. On the other hand, most business innovation programs are formulated by the Ministry of Economy and Energy mostly through the Directorate-General EU Funds for Competitiveness and the almost inactive National Innovation Fund.

EU funded OP Competitiveness is the main funding source to promote innovation and enterprise efficiency in Bulgaria. EU structural and cohesion funds are the main source of public funds available for upgrading and modernizing Bulgaria’s economy. With a budget of EUR1.162 million, OP Competitiveness is an overall framework that aims to support the ability of Bulgarian enterprises to compete internationally in the context of a global knowledge-based economy. Activities within OP Competitiveness relate to two specific objectives: (i) encouraging innovation and increasing the efficiency of enterprises, and (ii) improving the business environment.

As of September 21, 2012 the disbursed rate of the EU funded OP Competitiveness overall is 27.9 percent and the contracted rate is 55.6 percent. In particular, Priority Axis 1 of OP Competitiveness, which supports business innovation, has disbursed 2.53 percent and contracted 44.8 percent of its allocation. In particular, EU financing instruments supporting scientific research and innovation are designed and administered by different bodies, with limited coordination.

3.28. Overall, the strategies and policy definitions for scientific research and advanced human capital formation have been developed independently from the strategies and policies for innovation, despite the fact that both are critical components of the innovation system. Furthermore, it appears that current system favors short-term goals such as quick implementation of undisbursed programs, rather than introducing incentives to improve overall governance given the long time horizon for results.

3.29. Figure 3.1 depicts the organization of Bulgaria’s Innovation Governance System.
b) Recent Institutional Developments

3.30. The Ministry of Education and Science (MYES) and the Ministry of Economy and Energy (MEE) are the main policymaking and executive bodies in the areas of science and technology and innovation policy, respectively. Their functions are complemented by several executive agencies and advisory bodies. Other ministries (primarily Agriculture, Health, and Defense) are formally responsible for research activities within their respective areas.

3.31. There are two formal mechanisms for coordinating innovation policy – the National Council for Innovation (NCI) for MEE, and the National Council for Scientific Research (NCSR) for MEYS. The NCI has far fewer decision making powers than its counterpart at the Ministry of Education, Youth and Science, and serves only as an advisory body to the MEE, with very few meetings in the last few years and informally written proposals or studies on innovation policy.

3.32. The NCI was created in 2005 as a dedicated high-level coordination council responsible for implementation of the Innovation Strategy. In reality, however, the NCI mainly provides policy support to the MEE; it does not have its own budget, nor enables legislation. It is not involved in policy implementation, has no direct relationship with agencies in charge of implementing innovation programs and its influence as a coordination body is low. Although the Council was given new powers in 2011 to support the RIS3, it did not meet even once in 2012.

3.33. Formally, the mission of the NCI as a consultative unit to the MEE is to assist the implementation of the National Innovation Strategy by providing consultancy and analytical support.
3.34. The new powers given to the Council imply facilitation of joint activities among the authorities, scientific organizations, universities, NGOs, etc. in the areas of innovation and technology transfer. The Council’s responsibilities also include: recommending changes and new measures for implementation of the National Innovation Strategy; coordinating preparation of an annual report for the state; developing the innovation policy and approving innovation measures for the next reporting period. The Council is also expected to discuss draft laws related to the promotion of innovation in the country.

3.35. The NCI has eleven members. It is chaired by the Minister of Economy, and includes one person from each of the following institutions: the MEET, the Ministry of Education and Science (MES), the Ministry of Finance, the Council of Rectors of Universities, the Bulgarian Academy of Science, and the National Innovation Fund. The remaining members are from the business and NGOs. The Council operates on the basis of rules proposed by the MEE and approved by the Council of Ministers.

3.36. The Council adopts an agenda for its regular meetings on an annual basis. The agenda can be changed by recommendation from the Council's members. The Council meets at least once on every three months, as determined by the Chairman of the Council. At least 51 percent of the Council members must attend each meeting. The Chairman can invite to the meetings other physical or legal persons, as well as representatives from other organizations, to express their views on issues under discussion. The Council can also establish working groups to address concrete issues. Decisions are approved by majority vote in an open ballot.

3.37. Despite these formal responsibilities, in practice the Council has not had a significant role in influencing innovation policy in Bulgaria. It has met very rarely since its creation in 2005— a situation that has not changed since it was given new powers in 2011. The Council has therefore had little influence on the development of the NIS.

3.38. Among the main problems of Bulgaria’s innovation governance system are the lack of strategic direction (given the irrelevant role of the NCI), and to a lesser extent the NCSR. The policy and implementation level operate under the two pillar approach with very limited mechanisms of coordination. Therefore, the lack of coordination of the business innovation component with human capital and research policy limit the possibility of addressing innovation strategy, policy and implementation in a systemic manner. This leads to coordination failures and reduces the ability to generate innovation dynamics especially in emerging activities and immature clusters.

E. The Role of Innovation Councils in the National Innovation System

3.39. To promote the integration of science policy and technology development, there is a need for a holistic, multidimensional, and evolutionary approach to designing innovation strategies and policies. This approach involves:

- Setting a strategy to guide policy targeting and government intervention.
- Developing strategic intelligence for setting priorities in knowledge production.
• Enhancing horizontal coordination to reduce fragmentation and segmentation; this is especially important in division of labor models.
• Solving agency problems by vertical steering, to guide agents toward accomplishing certain goals.
• Preventing short-term political considerations from influencing resource allocation.
• Designing agencies with proper corporate governance and capabilities for efficient and effective implementation.
• Developing pragmatic public-private interfaces to promote knowledge flows and allow for a balanced push/pull interaction between research activities and business innovation.
• Integrating ongoing learning into governance practices.
• Developing and implementing action plans that include monitoring and reporting systems.
• Improving evaluation and learning and conducting meta-evaluations.

3.40. In the OECD countries, innovation councils tasked with promoting integration of science policy and technology development have typically evolved from 1980s-era. These science and technology councils advised governments on knowledge creation priorities. The second-generation councils are entrusted with promoting innovation in society as a whole. Table 3.2 shows a comparison of these newer innovation councils in 10 countries, including also the characteristics of Bulgaria’s NCI. Some common characteristics for influential second-generation innovation councils are:

• Participation of members from academy, industry and other ministries
• Own law or inclusion in “innovation law”
• Preparation of their own studies
• Possession of a secretariat with permanent employees
• Organization/attachment of working groups composed of stakeholders and academia (in all but one cases)
• Public reporting on activities and a position on key issues regarding development of innovation system in the country
• Uniqueness, in the sense of encompassing innovation as well as science and research.

3.41. Second-generation innovation councils could be divided according to two main types: strategic intelligence/advisory, and coordination. The different roles of advisory and coordination councils are discussed in the next section.
### Table 3.2: Cross-country Comparison of Innovation Councils

<table>
<thead>
<tr>
<th>Country</th>
<th>Council Name</th>
<th>Mandate</th>
<th>Composition</th>
<th>Membership</th>
<th>Other Ministers</th>
<th>Industry</th>
<th>Remit</th>
<th>Influence</th>
<th>Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Auton. Council</td>
<td>Science, Technology and Innovation Council</td>
<td>Research and Innovation Council Advising Council for Science and Technology Policy</td>
<td>Members: 8 members, including 4 ministers, 1 senior advisor, 1 coordinator</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>Advising Council; Advisory Council for Science and Technology Policy</td>
<td>3 deputy ministers; 1 senior advisor; 1 coordinator</td>
<td>Reports; Advice; Coordination; Commission for Science and Technology Policy</td>
</tr>
<tr>
<td>Canada</td>
<td>Council</td>
<td>Research and Innovation Council</td>
<td>Research and Innovation Council Advising Council for Science and Technology Policy</td>
<td>Members: 10 members, including 5 ministers, 1 senior advisor, 1 coordinator</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>Advising Council; Advisory Council for Science and Technology Policy</td>
<td>3 deputy ministers; 1 senior advisor; 1 coordinator</td>
<td>Reports; Advice; Coordination; Commission for Science and Technology Policy</td>
</tr>
<tr>
<td>Ireland</td>
<td>Government Council of Science and Technology</td>
<td>Council of Science and Technology</td>
<td>Council of Science and Technology Advisory Council</td>
<td>Members: 7 members, including 4 ministers, 1 senior advisor, 1 coordinator</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>Council of Science and Technology Advisory Council</td>
<td>3 deputy ministers; 1 senior advisor; 1 coordinator</td>
<td>Reports; Advice; Coordination; Commission for Science and Technology Policy</td>
</tr>
<tr>
<td>Italy</td>
<td>Government Council of Science and Technology</td>
<td>Council of Science and Technology</td>
<td>Council of Science and Technology Advisory Council</td>
<td>Members: 7 members, including 4 ministers, 1 senior advisor, 1 coordinator</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>Council of Science and Technology Advisory Council</td>
<td>3 deputy ministers; 1 senior advisor; 1 coordinator</td>
<td>Reports; Advice; Coordination; Commission for Science and Technology Policy</td>
</tr>
<tr>
<td>Japan</td>
<td>Cabinet Office</td>
<td>Council of Science and Technology</td>
<td>Council of Science and Technology Advisory Council</td>
<td>Members: 7 members, including 4 ministers, 1 senior advisor, 1 coordinator</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>Council of Science and Technology Advisory Council</td>
<td>3 deputy ministers; 1 senior advisor; 1 coordinator</td>
<td>Reports; Advice; Coordination; Commission for Science and Technology Policy</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Government Council of Science and Technology</td>
<td>Council of Science and Technology</td>
<td>Council of Science and Technology Advisory Council</td>
<td>Members: 7 members, including 4 ministers, 1 senior advisor, 1 coordinator</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>Council of Science and Technology Advisory Council</td>
<td>3 deputy ministers; 1 senior advisor; 1 coordinator</td>
<td>Reports; Advice; Coordination; Commission for Science and Technology Policy</td>
</tr>
<tr>
<td>Switzerland</td>
<td>National Science and Technology Council</td>
<td>Council of Science and Technology</td>
<td>Council of Science and Technology Advisory Council</td>
<td>Members: 7 members, including 4 ministers, 1 senior advisor, 1 coordinator</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>Council of Science and Technology Advisory Council</td>
<td>3 deputy ministers; 1 senior advisor; 1 coordinator</td>
<td>Reports; Advice; Coordination; Commission for Science and Technology Policy</td>
</tr>
<tr>
<td>UK</td>
<td>Council</td>
<td>Council of Science and Technology</td>
<td>Council of Science and Technology Advisory Council</td>
<td>Members: 7 members, including 4 ministers, 1 senior advisor, 1 coordinator</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>Council of Science and Technology Advisory Council</td>
<td>3 deputy ministers; 1 senior advisor; 1 coordinator</td>
<td>Reports; Advice; Coordination; Commission for Science and Technology Policy</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>The Bulgarian National Council for Science and Technology</td>
<td>Council of Science and Technology</td>
<td>Council of Science and Technology Advisory Council</td>
<td>Members: 7 members, including 4 ministers, 1 senior advisor, 1 coordinator</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>3 deputy ministers: Health, Science, Technology; 1 other minister: Education; 1 other minister: Industry</td>
<td>Council of Science and Technology Advisory Council</td>
<td>3 deputy ministers; 1 senior advisor; 1 coordinator</td>
<td>Reports; Advice; Coordination; Commission for Science and Technology Policy</td>
</tr>
</tbody>
</table>

*Construction of a previous council

Source: OECD 2005 and author’s elaboration.
a) Advisory Councils

3.42. Advisory councils focus on long-term issues and trends that need to be taken into account in defining innovation strategies. These councils monitor global trends in key technology areas, and conduct meta-evaluations of the country’s innovation system and processes, leading to policy learning. They also reduce dynamic inconsistency and short-horizon planning through a process of consensus building to raise society’s awareness of the long-term benefits of research and innovation. Most strategic advisory councils are associated or integrated with prestigious academic institutions, and include business leaders and representatives of relevant ministries. Most conduct consultations with stakeholders and communities when formulating new policy. There is a role for advisory boards with a long-term perspective to undertake meta-evaluation of the overall innovation strategy. This role has been addressed with multidisciplinary expert panels. A critical issue for Advisory Councils becomes how to secure that it would have influence in stakeholders decision making and attitude toward innovation, in government policy and society as a whole. Cross country examples (Table 3.2: Cross-country Comparison of Innovation Councils) show that advisory councils with a higher degree of influence on society and policy making conduct studies such as foresight analyses, disseminate them through a small but stable secretariat, and have their roles clearly established in primary legislation.

3.43. We highlight the following examples of advisory councils:

- The Austrian Council for Research and Technology Development, established in 2000, has important influence on government policy. It periodically publishes medium-term agendas for research and innovation.
- The Science, Technology and Innovation Council of Canada, established in 2007, provides holistic advice to government across science and innovation in support of the new national science, technology and innovation strategy. It provides private (non-public) advice to the government.
- The Council for Science and Technology Policy (AWT) of the Netherlands is an advisory council oriented to long-term strategic issues. It coexists with a coordination board, each one with its own secretariat.
- Slovenia has recently reorganized two councils into a single National Research and Innovation Council, which plays an advisory role to the government.
- The Swiss Science and Technology Council is an advisory council focused mostly on science, with limited influence in innovation policies.

b) Coordination Councils

3.44. In the countries with a division of labor model, it is very challenging to ensure horizontal coherence between policies oriented to business innovation and development, and policies seeking to promote science and technology and advance human capital formation. Countries have developed coordination bodies to promote coherence in addressing coordination failures in the processes of self-
discovery and technological and human capital upgrading in sectors with high potential. Coordination councils focus on planning and horizontal coordination across ministries, with the goal of aligning policies with overall strategy. They also play a role in evaluating existing programs and instruments and designing new ones. There are several distinct types of coordination councils, all of which contemplate the participation of ministers involved in policy making for business development, science, education, and technology development. Some councils are headed by the prime minister or president of the country, and most include the participation of non-government experts. In most cases, the council also plays a long-term advisory role. Examples of coordination councils in OECD countries are described below:

3.45. The chairman of the Finnish Research and Innovation Council is the Prime Minister, with the participation of other ministries, academics and business people. The Council provides strategic direction in research and innovation policy. The Council was very influential during the 1990s.

3.46. The Netherlands created in 2003 the Innovation Platform as a coordination council headed by the Prime Minister, and the participation of the Ministries of Education and Economic Affairs. It was very active in proposing projects or new instruments oriented to solve problems in the innovation system. The Innovation Platform played a fundamental role in the development and launching of the new innovation agenda of the Netherlands. Nevertheless, there was significant overlap with advisory board (AWT). It stopped function in May 2010 with the change in government, nevertheless a new initiative was launched without government representatives that play a role of coordination and advocacy for the Knowledge and Innovation Agenda (KIA) for 2011-2020.

3.47. The Council for Science and Technology of the UK advises the prime minister and also plays a coordination role across ministries on defining innovation policies which requires having consistent science, technology and research policies. The Chief Scientist (Chief Scientific Advisor) co-chairs the Council with a private sector representative.

3.48. Japan went further redefining in 2001 the role of the Japanese Council for Science and Technology Policy, bringing together six ministries with academics and business with a strong planning and coordination role, allocating budgets and defining policy and supervising implementation. The secretariat is comprised by more than 100 professionals. In practice, it became a horizontal Ministry of Innovation, with strong coordination and detailed policy making across all the sectors linked to research, technology development and innovation.

3.49. Another example of coordination is related to cluster development innovation policies, which may involve several agencies from different ministries. For example, the fish farming industry cluster in Norway has been supported by the Ministries of Fisheries, Agriculture, Trade, and Industry and Environmental Affairs (OECD 2012).

Box 3.2: Institutional Innovation in Chile

Chile, a country that joined OECD in 2010, has been very active in the institutional development of innovation system. In 2005 it created the National Council for Innovation and at the same time introduced a royalty in mining.
allocated exclusively to an innovation fund. The Chilean Council has been responsible of preparing the National Innovation Strategy, which was launched in 2007 and coordination with ministries overseeing its implementation. It makes recommendations on priorities and budget allocation. The Council President is appointed by the president and should not be a member of the government. The Council has a secretariat with 10 professionals. Four Ministers participate in the Council.

The actual implementation of policy and the decisions on budget allocation correspond to the Ministerial Innovation Coordination Committee, which proposes a detailed allocation of the Innovation Fund to the Ministry of Finance. The Minister of the Economy is the Chairman of the committee and the Undersecretary of the Economy act as the secretariat.

The creators of the Chilean model are in a process of rethinking the structure of both boards for better governance. The restructuring would contemplate keeping the National Innovation Council as an Advisory Board and to extend the Ministerial Committee as a Coordination Board headed by the Minister of Economy, with the participation of the Minister of Education and several sector ministries. This also includes the participation of the President and Vice President of the Advisory Board, all of this established by law with clearly defined mandates.

c) Governance Principles

3.50. Effective policymaking to support innovation is complex, given the long-term impact and systemic nature of innovation and the significant risk of capture by stakeholders. In this context, institutional arrangements should embody the following governance principles (World Bank 2007):

- Clarity of vision, objectives, and strategy. After the situation has been diagnosed and barriers to innovation identified, it is necessary to clearly define (a) expected outputs and outcomes; and (b) inputs, lines of action, and strategic initiatives needed to achieve them. A national consensus on the political and social goals of innovation can partially mitigate the risk of government inconsistencies by supporting a long-term vision that transcends short-term interests, giving legitimacy and stability to the decisions taken, and facilitating policymaking over a long time horizon.

- Clear jurisdiction and mandate of responsible institutions. It is important to clearly separate the long-term strategy function, typically carried out by the Advisory Council, from the coordination and implementation functions, which are the prerogative of government. Each type of institution must have the authority and instruments needed to effectively carry out its role.

- Coordination mechanisms at various levels. Establishing a national innovation system is a complex undertaking that requires the participation of many institutions. The challenge is to put in place mechanisms that balance coordination with interdependence, in order to prevent duplication of efforts, reduces transaction costs and information problems, and take advantage of possible synergies.

- Transparency and accountability. Both are key elements of effective governance. Transparency and accountability mechanisms can include:
  - Oversights by institutions that do not participate in the decision making process but are in a position to demand good performance (e.g., external audit agencies).
- Consideration of private sector experience in designing programs and tools, and incorporating private sector feedback into assessments of institutional performance, taking due care to avoid potential capture hazards.

- Establishment of formal M&E mechanisms and feedback loops at different levels of government to inform decision making and guard against capture.

- Establishment of independent, external M&E entities.

- Timely public access to information on decision making processes, criteria and procedures for allocation of resources, and project performance.

- Integrating learning into policy and practice. Good governance also requires that the system has the ability to continually adapt to change, and to incorporate lessons from both successes and failures.

**Box 3.3: Stages of Policymaking**

1) Agenda setting and prioritization to define the policy objectives. These processes include both national and sectoral strategy setting. This part of the policy cycle is strongly influenced by different interest groups and is based on an analysis of why certain issues are on the policy agenda and how they got there. It also includes processes of setting up national institutions and organizational structures.

2) Design. In this part of the policy cycle, issues on the agenda are formulated into concrete initiatives, programs, or policy measures with specific targets or objectives.

3) Implementation is the phase in which plans are put into practice. Design is sometimes modified during this stage as a result of changes in context and learning from experience.

4) Evaluation is an important part of the policy cycle. Here policies that were formulated and implemented are evaluated. These evaluations are often *ex post* but increasingly *ex ante*.

5) Policy learning is defined as all those processes by which policy systems generate and incorporate knowledge and understanding about: *i*) preconditions for the success of policy initiatives; and *ii*) their direct and indirect impacts. This knowledge is derived throughout the policy cycle, and policy learning feeds back into future policy initiatives.

**F. Proposal for a Coordination Body for Bulgaria – the National Knowledge and Innovation Board (NKIB), and the Innovation Advisory Council (IAC)**

3.51. Smart specialization means establishing priorities in research, technological infrastructure and advanced human capital. Coordination and consistency over time with strategy are essential ingredients for success. Of course the development of implementation capacity, creation of strong agencies, with proper governance, clear mandates, oversight, and performance evaluation are critical first steps in the development of the innovation system. A well-structured council could play a key role in creating the momentum for the development of these agencies. The proposal considers in first phase the creation of a standing alone Innovation Implementation Agency in charge of managing the innovation and business development programs with a proper corporate governance, that will generate focus and accountability in implementation. In defining the Smart Specialization Strategy it is important to have a process of consultation and dialogue with key stakeholders of Bulgarian society. The goal is to have a process that
will provide legitimacy to the government proposal and transform it into the National Strategy of Innovation. Next we address how to integrate in a consistent way both the advisory and coordination functions into Bulgaria’s institutional setup (see Figure 3.2).

Figure 3.2: Proposed Innovation Support System Institutional Arrangement*

*National Innovation Board and National Knowledge and Innovation Board refer to the same institution

a) How to Integrate Coordination and Advisory Roles

3.52. International experience has shown that a successful innovation system requires both coordination and strategic intelligence. The challenge for Bulgaria is to integrate both of these functions into its Smart Specialization Strategy. For that purpose we propose a Coordination Board and an Advisory Council (Figure 3.2), a scheme that has worked in countries like the Netherlands and Chile.

3.53. The National Knowledge and Innovation Board (NKIB) will act as a coordination body. In addition to coordinating the innovation and research agenda the NKIB, through its secretariat, would also monitor and evaluate the innovation policies and strategies of different agencies and provide feedback for learning. The NKIB will also make sure that issues considered in the 6 regional strategies are taken into account in the National RIS3 strategy.

3.54. The Innovation Advisory Council (IAC), comprising stakeholders and experts, would focus on long-term strategic issues. The Advisory Council would have a small secretariat (see Figure 3.2). That would strengthen its independence and capacity to define its own agenda and increase influence on the
NKIB. The IAC would not be subordinated to the NKIB. Such institutional arrangement would allow the NKIB to play an effective coordination and policy role, while the IAC would ensure the continuity of strategic advice and intelligence.

3.55. This institutional design should guard against a situation such as in the Netherlands, where significant overlapping between the advisory and coordination council was experienced, or Chile, where the National Innovation Council has become less relevant vis-à-vis the Ministerial Committee of Innovation – thus contributing to the segmentation of the system instead of promoting convergence in policy view and strategic priorities. The clear differentiation of roles between strategic advice and intelligence from horizontal and vertical coordination and evaluation will help to prevent these problems. At the same time, incorporating members of the Advisory Board into the NKIB will improve communication between these entities and enhance accountability for policy coordination and implementation.

b) Members of the NKIB and Innovation Advisory Council

3.56. The members of the NKIB would represent all sectors relevant to the innovation and research agenda. The NKIB should ideally be chaired by a top-level government official such as the Prime Minister or Deputy Prime Minister (as in Finland, for example). The ministers of Economy, Education, and Finance would be permanent members, with three other ministers representing high-priority sectors appointed by the Prime Minister. The NKIB would also include the following members of the Innovation Advisory Council: the chairman; three private sector actors (one each) in the areas of high-tech, a more traditional sector targeted for innovation, and finance or venture capital; two academic experts (one each) in innovation policy and human capital policy; and a reputed scientist. In addition, the NKIB would include a representative of Bulgaria National Academy, the heads of two national universities, and one international expert. As explained in the legal section of this chapter, the IAC members can only have voice in the NKIB and not voting rights.

3.57. The goal of the participation of relevant members of the IACs for enhancing coherence between the strategic long-term view of the council and short term policy agenda of the NKIB. It attempts to reduce time inconsistency of the government. It also prevents a situation where the IACs perceived irrelevant by the government, since it is required by law to give an opinion on policy issues from a long-term perspective.

3.58. The NKIB would have a technical secretary with high professional capabilities and an executive secretary. NKIB staff should have competencies in public policy, impact assessment, econometrics, innovation, research, and human capital policy (See Figure 3.3).

3.59. The secretariat of the IAC would include a minimum staff of two or three professionals (Figure 3.3: Proposed Innovation Support System Institutional Arrangement – Proposed Structure of the NKIB and Advisory Council*). The secretariat’s role would be to produce/contract out position papers and
studies, as well as organization of events for their dissemination. This secretariat will strengthen the IAC’s independence to define its own agenda and will increase influence on the NKIB.

3.60. The independence and impartial stance of the IAC members would be guaranteed by the process and nature of their appointment. This will have three features: (a) the advisory council members are designated jointly by high level officials representing different powers of the state (i.e. Prime Minister and President); (b) their roles are clearly defined in the legislation (i.e. Innovation Law); (c) the members’ tenure goes beyond the horizon of the appointing government.

**Figure 3.3: Proposed Innovation Support System Institutional Arrangement – Proposed Structure of the NKIB and Advisory Council**

- Presided by Prime Minister/ DPM
- Representatives from key government ministries
- Representatives from private sector and academia
- International experts

Members of the business and research communities, international experts, members of professional education

**Box 3.4: Assessing Stakeholder Involvement in Innovation Councils**

**Positive aspects**
- Increases the user orientation of policies and consequently their effectiveness
- Invites more transparency on the rules of the game
- De-politicizes some contested decisions
- Circumvents departmental turf fights
- Facilitates networking between different stakeholder groups

**Negative aspects**

*National Innovation Board and National Knowledge and Innovation Board (NKIB) refer to the same institution*
- Lengthens the decision-making process
- Increases the transaction costs of policy making
- Composition of stakeholder groups can be skewed in favor of certain interest groups or positions

c) NKIB Legal Status

3.61. First, the NKIB would replace the two existing councils (NCI and NCSR), would be a state agency attached to the Council of Ministers (COM) and could have ministry status. Ideally, the NKIB would be established by primary legislation (i.e. the new Law on Innovation), but it could also be established by COM regulation as a fast track alternative. A formal legal status would entitle the NKIB to an appropriate level of funding, including for its secretariat.

3.62. NKIB inclusion in the Innovation Law would define, in the greatest possible detail, the composition of the NKIB, its functions, roles, responsibilities, staffing, budget, etc.; as well as the relationship between NKIB and the implementation bodies and the relationship between the NKIB and other executive bodies.

3.63. The fast track alternative to this option would be adopting the governance mechanism by way of COM regulation (submitted by the Minister of MEE). However, it would be imperative to have an explicit condition by which the governance mechanism established by regulation will be later folded into the Law on Innovation.

3.64. Second, while the NKIB will not directly manage the implementation agencies, it would advise and influence their leaders. Considering that the heads of the agencies are appointed by the Ministers, and the Ministers are members of the NKIB, it is highly likely that the agencies’ heads would consider and implement the decisions of the NKIB.

3.65. Third, the participation of private sector and all non-public officials in general, as NKIB members, depend on the Executive’s decision. The channel to mandate the involvement and participation of non-public officials in the NKIB would have to be approved by the legislative branch, i.e. the Parliament. Moreover, by law, civil servants or political appointees (Cabinet Members, Deputy Ministers, and Chiefs of Staff of Ministries) cannot be subordinated to private citizens. Public officials are ultimately subordinated to the Prime Minister who is the embodiment of executive power and in turn subordinated to the ruling majority in Parliament.

3.66. The impossibility of private sector decisions having authority over the Executive opens up prospects of having private sector actors as members of the Advisory Council to NKIB, which has purely consultative functions.
3.67.

**d) Monitoring Role of the NKIB**

3.68. The NKIB secretariat’s role in monitoring and evaluation would be to:

i. Set quality standards and a framework for evaluating individual institutions, programs, and actions;

ii. Ensure that evaluation mechanisms are embedded in the normal processes of the implementing agencies;

iii. Conduct thematic evaluations of progress in priority areas;

iv. Require evidence-based approaches to policy assessment and advice;

v. Set performance indicators for services provided by the implementing agencies;

vi. Build a knowledge base on the effectiveness of different types of policy interventions;

vii. Assess the performance of policymakers, program managers, and implementing agencies, and holding them accountable for shortcomings;

viii. Provide space for monitoring and evaluation by stakeholders, and incorporating their feedback to improve programs and processes.

3.69. The purpose of monitoring and evaluation is to enable the NKIB to assess the efficiency and impact of the innovation programs. Ensuring proper functioning of the system will depend on three levels of evaluation¹⁰⁰ (See Figure 3.4). The first level would focus on the overall efficacy of the innovation system; the second on the routine evaluation of individual interventions; and the third on analyzing bottlenecks and assessing the performance of institutions and actors in the system. Since some types of information are available only from decentralized entities, routine evaluation and analysis of bottlenecks should be embedded in innovation agencies, programs, and projects at all levels.

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Figure 3.4: Monitoring of the Innovation System

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3.70. Since it is difficult to measure the progress of initiatives with a long maturation period, the NKIB should establish intermediate indicators that indicate the direction and pace of change. These could include:

- Successful implementation of the innovation related programs in national reform program of Bulgaria. One of the objectives listed in the reform program is increasing R&D investments to 1.5 percent of GDP by 2020. Another objective is the adoption and implementation of new innovation strategy. Indicators on these and other country level objectives could be monitored by the secretariat of NKIB.
- Adoption of an implementation framework by key ministries.
- Improved vertical and horizontal policy coordination among ministries and agencies.
- Evidence of an improved climate for investing in innovation (ease of doing business, financial support for innovation).
- Increased public awareness of the importance of innovation.
- Increased government budget for research and innovation.

3.71. Several countries such as Chile, Finland have coordination bodies with M&E roles; others as Slovenia and the US implement M&E through the innovation policy implementation agencies (see Box 3.5).

**Box 3.5: International Experiences on Monitoring and Evaluation Roles of Coordination Bodies**

**Chile:** The National Innovation Council for Competitiveness (CNIC) is established as the proper institutional framework that will design the overall innovation strategy and coordinate, monitor and evaluate its implementation. Until its establishment, there was no official permanent organization in Chile responsible of such tasks.

The scope of CNIC’s work in evaluation encompasses setting quality standards and a framework for the evaluation of institutions and programs. This includes evaluation of two most well-known agencies implementing innovation and research policies in Chile, i.e. CORFO and CONACYT. The council is also responsible from carrying out thematic evaluations of the whole national innovation system from a systemic perspective. In addition, the council also works with the development and implementation of regional innovation strategy and reports its progress.

**Slovenia:** In 2011, Regional Innovation Strategy of Slovenia (RISS) was adopted by the Slovenian government. The strategy includes various proposals for better evaluation instruments and a corresponding evaluation culture. According to the RISS, evaluation system will be developed by the agencies responsible for research and technological development in cooperation with the competent ministries and stakeholders. For each program, independent groups of domestic and international experts will monitor the achievement of objectives, the effects and implementation of measures and report annually to the respective advisory bodies in the Government.
**Finland:** The Research and Innovation Council (which was previously known as the Science and Technology Policy Council of Finland (STPC)) does not actively participate in monitoring and evaluation of the innovation system. However it commissions reports and advises the Government and its Ministries in important matters concerning research, technology, innovation and their utilization and evaluation. Evaluations use international panels of peers and their results and recommendations are publicly published.

TEKES and the Academy of Finland commission regular studies and evaluations regarding the Finnish innovation ecosystem and their role in it. TEKES has a department that handles both evaluation and the agency’s system for project-level impact assessment, attempting to estimate the economic effects of TEKES funding.

The Ministry of Employment and the Economy regularly commissions independent evaluations of TEKES on its performance and role in the ecosystem. In addition to these evaluations, TEKES is obliged to regularly report to the ministry about the activities it has pursued to meet the goals negotiated between the ministry and TEKES.

**US:** Since establishment of the Government Performance and Results Act (GPRA) in 1993, the US has been emphasizing the production and use of performance information in the budgeting process. The act focuses at the level of agencies and requires every agency to: a) make a strategic plan every three years that define missions, establish results-oriented goals and identify the strategies that will be needed to achieve those goals, b) translate the three-year plan into specific annual performance plans with quantified targets and performance indicators, c) report every year on the extent to which the targets were met and explain what corrective actions are being taken where performance is below plan.

d) NKIB and Innovation Advisory Council Responsibilities

3.72. The elaboration of the Smart Specialization Strategy presents an excellent opportunity to launch the NKIB and the Innovation Advisory Council (IAC). The IAC could play a role in establishing a space for consultation to achieve consensus and stakeholder buy-in regarding the Strategy, which the NKIB could then formally approve it once the process is finalized. The NKIB could then coordinate the work of transforming the Strategy into an action plan with clear targets and responsibilities, while the Advisory Council could undertake studies to identify medium-term priorities for aligning science and research with business innovation.

3.73. In the first phase of Strategy implementation, the NKIB should work with the MEE to allocate resources in alignment with strategic priorities to the ministries and agencies responsible for business innovation, scientific research, and human capital formation. The ministries would then contract various implementing agencies. The contracts, to be approved by the NKIB, would specify the eligible beneficiaries for each initiative, the level of co-financing, the role of intermediaries, expected outputs and outcomes, type of impact assessment, and medium-term indicators.

3.74. The implementing agency (ies) would be responsible for the detailed design of each instrument, under the supervision of the sector ministry. Program evaluation could be undertaken by line ministries, using a methodology agreed with NKIB. There would be a periodic reassessment of budgetary priorities based on the country’s need for research programs, business innovation, technological infrastructure,
technology development adaptation and diffusion, advanced human capital formation, and base funding for universities and institutes. Establishing coherent budgetary priorities for the overall innovation system is one of the important tasks of the proposed NKIB. In that context Chilean experience could be taken into consideration, where one of the most important reforms was to ensure a coherent systemic allocation of resources consistent with the agreed strategy. When that was solved in a bilateral negotiation with the Minister of Finance, it was unlikely to end up with inconsistent budget allocation across areas.

**G. An Alternative Institutional Design and Governance Structure**

3.75. An alternative option to NKIB and IAC would be to have a single body that would comprise the two entities integrating the coordination role and the long term advisory function. The advantage of this alternative are reduced number of institutions and limited overlaps in responsibilities between the NKIB and the IAC, a problem that had emerged in the Netherlands. The disadvantages are weakened long-term vision and check and balance of short term bias of a government controlled body. Therefore a second best option could be engaging external expertise and a more long-term independent perspective by having a permanent Strategic Advisory Committee (SAC) and ad hoc ones. The presidency of this SAC shall be given to one of nongovernment members of NKIB. In order to maintain the independence of the nongovernment members of the NKIB it is crucial to maintain a process of appointment with the participation of two powers of the state. It could be the Prime Minister and the President or the Parliament. Also it is fundamental that these members are appointed for a period that exceeds the term of the government.

3.76. The nongovernment members should bring special expertise on research, business innovation, human capital, and cluster policy and also on technology management and financing of innovation. There are different options for structuring a long-term advisory function in the NKIB. One is to structure permanent advisory committees headed by the independent experts of the NKIB. The President of each committee will invite specialists and stakeholders to contribute and participate in the committee and will also manage a small budget for studies. Another option is to structure the Committees on ad hoc basis depending on the needs of the NKIB. Also a combination of both approaches could be implemented.

3.77. The nongovernment members of the Board will have only voice rights according to Bulgaria’s legislation. This will weaken its influence and the ability to keep temporal coherence on innovation and research policy. The structuring of the permanent advisory committees with formal and extensive consultation with members of the civil society and stakeholders will help in creating more accountability.

3.78. A particular area where the NKIB could play a key role and use extensively the committees is on the assessment of the road mapping exercise. The technical secretariat of the NKIB will be in charge of collecting from the Innovation Implementation Agency the results of the sector road mapping exercises with a preliminary assessment and evaluation. The secretariat’s duty will be to generate a process of consultation with sector Ministries and agencies for defining a proposed implementation agenda. It should also present the road mapping results to the Committees for opinion on the recommendations. The final decision on road mapping action plan and implementation should be made by the Board.
3.79. Also the Committees could be given the task to develop a process of consultation and studies that could lead to the definition of mission oriented research priorities and advance human capital priorities. These studies could be useful for creating strategic orientation in the financing of collaborative research initiatives and advance formation of relevant capabilities.

**H. The Innovation Implementation Agency**

**a) The case for a specialized implementation agency**

3.80. In Bulgaria the implementation of programs funded by EU’s structural funds, specifically those under MEE’s OP “Competitiveness” have been hampered by operational constraints related to: a) inefficient project selection process, which is complex and lengthy (more than a year for PA1 between the approval of the selection criteria of operations and the announcement of the Application Guidelines), b) long periods with no new calls for proposals (e.g. only one call was launched under PA1 & PA2 during 10.2008-03.2010), c) lack of involvement a sufficient number of evaluators with adequate technical and commercial experience in the technical project evaluation process.

3.81. To overcome these operational constraints the Innovation Strategy should be managed by a specialized, stand-alone agency that is concerned with providing the public services needed to support innovation. Unlike a policymaking entity, the implementation agency would accumulate expertise in detailed design of specific programs and instruments proposed by the ministries. The separation of implementation from policymaking will prevent excessive political influence on technical tasks.

3.82. The implementation of business innovation programs has some particular characteristics which differ from other public services. These programs require complex technical evaluations, a broad understanding of business innovation processes, and informed judgments about how to handle the risks of capture by beneficiaries. A stand-alone agency can help to get the governance of these programs right, and ensure transparent and efficient implementation and alignment with policy goals.

3.83. The Innovation Implementation Agency should be created by law and have key staff selected on the basis of merit, without reference to political considerations. This will transform the agency into a repository for knowledge and experience on innovation policy and practice.

3.84. The Innovation Implementation Agency would manage national and EU funding for innovation.

**b) Guidelines and principles**

3.85. **Corporate governance of Execution Agencies.** At the intermediate level, between the ministries responsible for policy making and the beneficiaries of innovation policy, it is fundamental to develop a standalone agency with the responsibility of detailed design of the programs and their implementation. For these institutions to play its role in an efficient and effective manner there are certain requirements that we address in what follows:

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Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013”, financed under Priority Axis 5 “Technical Assistance” of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
- Clear definition of scope of action by NKIB. One of the first tasks of the NKIB should be to establish for implementation agencies a clear mandate, specifying the type of instruments and beneficiaries that they should target. In the division of labor model there is at least one agency in charge of programs oriented to businesses as beneficiary, and another with instruments focused on researchers and research organizations. In the case of Bulgaria we have proposed the development of an Innovation Implementation Agency that also takes the responsibility of technology diffusion in the SME sector. In addition, the National Research Fund should also be strengthened as a stand-alone agency, with proper corporate governance, clear mandate, transparency and accountability. It is important to avoid duplication of instruments, since competition in providing subsidies creates incentives for arbitration by beneficiaries among agencies. In grey areas proper coordination should be required.

- Governance structure for Innovation Implementation Agency and the National Research Board. Each agency should have a board of directors responsible for overseeing the functioning of the Agency, appointing the CEO and approving each performance contract for the management of each program with resources allocated from the budget. In the division of labor model, the minister in charge of each policy area should be the chairman of the board of the respective implementing agencies: the Minister of Economy as a chairman of the Innovation Implementation Agency and the Minister of Education as a chairman of the National Research Board. The board should also be constituted of experts in the field, appointed by NKIB.

- Advisory Committees for programs. In programs where it is important to have an integrated assessment of proposals and expert evaluation, it would be relevant to have an advisory committee to advise on projects selection and assessment of program operation. These committees should be composed of business representatives, innovation experts and scientists.

- Selection of the CEO. The best option would be to have the selection of the CEO of the Agency by the entire board, with a public process based on merit and with a clear job description.

- Transparency and accountability. The implementing agency should be required to publish on its website all the information about the execution of each innovation program, except for the information that is confidential due to intellectual property issues. Every four years there should be a comprehensive independent evaluation of the Agency and an impact evaluation of each program. The independent evaluation should be hired by the ministry with prior consultation with the NKIB for agreeing on evaluation methodology. The formal opinion of the Innovation Advisory Council is also advisable.

- Interlocking directories. In order to have better coordination across agencies it is important to have cross participation of directors in the boards of the agencies that have complementary tasks.

- Regional coordination. Regions should have at least the possibility of establishing Regional Innovation Advisory Councils for proposing long-term innovation strategies and priorities relevant to the region. These proposals should be brought into the consideration of the Innovation Advisory Council. The Council should try to introduce coherence into the vision of different regions with goal of taking advantage of complementarities, promoting specialization and preventing duplication. Since clusters do not respect regional boundaries, building a shared macro regional vision of cluster development would be an important step towards solving coordination failures and creation of strategic capabilities for generating innovation dynamics in clusters.

- Management contract for each program. Each program has to be agreed upon with a ministry that
makes the transfer of resources. The contract should establish the targeted beneficiary, the overall description of the instrument, the failure that is trying to correct, the co-financing by the beneficiary, the intermediary eligible for managing resources, the mechanism of compensation to intermediaries, the execution indicators and the goals for the period, and the information that has to be raised for impact assessment. The contract would have to be approved by NKIB. Contracts would include criteria for the detailed design of the instruments, deadlines, the amount of resources to be allocated, the type of evaluation methodology in each stage, and also outcome indicators to be obtained from program’s impact evaluation.

- Performance contract, strategic creation of capabilities and accountability. Performance contracts have been used in the area of innovation and technology development and science between the state and executing institutions like Technology Development Institutes, Research Centres and Universities. The purpose of these contracts has been twofold: i) to link the creation of capabilities to a more focused strategic orientation, consistent with the mission of the institution and ii) to generate base financing for maintaining critical capacities for the functioning of the entity. Performance contract is a useful instrument when is associated with an institutional strategic planning targeting performance improvement. It usually incorporates intermediate targets related to capability creation, improvement of processes as well as development of performance index linked to the mission of the institution.

**Performance Contracts with Universities and Technology Institutes**

3.86. The process of restructuring of Universities and Centers of the Academia could be accomplished through a voluntary process where institutions apply for financing for creation of strategic capabilities. The prerequisite for applying for this funding should be to start a formal process of strategic planning with external oversight. The scheme should be implemented starting with a self-evaluation process of participating institutions. This self-evaluation should be assessed by an international expert panel which would submit feedback to the institution. With this opinion the institution would undertake a strategic planning exercise with external advice. The strategic plan would contain an action plan identifying the strategic focus of each organization, the capabilities that should be developed or enhanced and the outcomes that should be expected with clear indicators how to measure them. The action plan should also be assessed by an international panel, providing relevant benchmarking for the evaluation. Those institutions that formulate strategic plans consistent with NKIB priorities and are willing to be subjected to periodic evaluation and adjustment during implementation would be able to have a performance based contract with a sectoral Ministry, once approved by NKIB. This contract would provide base financing and resources for development of capabilities in a long term perspective. The requirement of co-financing derived from technology services or R&D contracts with business will depend on the nature of supported activities. Those with a higher component of public good or more basic long-term knowledge creation would require less or none co-financing from private sources. Nevertheless, still it would be necessary to gain projects from national and/or European or international sources. The typical financing base for research and technology centers should range between 30 and 50 percent. In the case of complex universities with significant research activity and third mission, financing base should range between 10 to 20 percent, depending of the availability of competitive grants for basic research and the policy of self-financing with tuition financed by the students, state scholarships and loans.
3.87. **Performance Based Management Agreements** have been developed for improving performance and outcomes of public services in different OECD countries. In some cases the creation of capabilities have been negotiated and conditioned. In others even additional pecuniary and non-pecuniary compensation to the personnel has been linked to outcome indicators. A very interesting option is to explore a pilot case for structuring a Performance Based Management Agreement with the innovation agency subject to a special labor regime, where employees from certain level up could have a variable component of remuneration. In the case of the Innovation Implementation Agency the proposal is that the agreement could be signed by MEE but with the approval and review by the NKIB and with participation of the Ministry of Finance. The new institutional structure would have to be created by law if a different labor compensation scheme is to be implemented.

3.88. **Scope of the Agency: Business Innovation or Competitiveness and Business Development**

Governments have a variety of ways to support innovation. Table 3.3 illustrates a comparison among nine implementation agencies in seven countries. All of them provide subsidies in form of matching grants for innovation and science and technology projects. On the other hand, few provide financing for fixed capital purchase of financial incentives. On the nonfinancial instruments, all agencies offer knowledge management services (e.g., information services and technology diffusion).

3.89. Also some countries have pooled together in the same agency the innovation promotion activities with broader business promotion functions. Among these other functions that have been brought under one umbrella organization are:

1) SME’s instruments for upgrading its management and technology absorption capacity and the promotion of cooperation among SMEs for developing club goods for solving coordination failures and instruments to promote linkages among world class corporations and small businesses.

2) Target promotion of R&D and technology intensive FDI.

3) Development of financial mechanisms for promoting financing for SME’s, start-ups, as well as for long term financing.
Table 3.3: Implementation Agencies – Types of Instruments Used

<table>
<thead>
<tr>
<th>Agency</th>
<th>Financial Instruments</th>
<th>Non-Financial Instruments</th>
<th>Regulatory Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subsidies</td>
<td>For Fixed Capital</td>
<td>Financial Incentives</td>
</tr>
<tr>
<td>AIF (Germany)</td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Enterprise Ireland</td>
<td>*</td>
<td>*</td>
<td>*</td>
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<tr>
<td>Novem (Netherlands)</td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Senter (Netherlands)</td>
<td>*</td>
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<td>*</td>
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<tr>
<td>NSTB (Singapore)</td>
<td>*</td>
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<td>*</td>
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<tr>
<td>KEITECH (Korea)</td>
<td>*</td>
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<tr>
<td>KISTEP (Korea)</td>
<td>*</td>
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<tr>
<td>Vinnova (Sweden)</td>
<td>*</td>
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<td>*</td>
</tr>
<tr>
<td>CIST (UK)</td>
<td>*</td>
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<td>*</td>
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</tbody>
</table>

3.90. Agencies with such diversified approach exist in developed economies like the Economic Development Board in Singapore, Enterprise Ireland in Ireland which also include export promotion activities and Enterprise Connect Australia. In emerging economies there are two interesting cases. First, CORFO of Chile, Agency that includes business innovation, instruments for financial sector development, in particular for start-up financing and venture capital development, attraction of FDI in key strategic areas, cluster development and energy efficiency and clean production. Second, Bancoldex of Colombia that combines in one agency development of financial sectors, SMEs programs and business innovation.

3.91. For an emerging economy, where coordination failures and information asymmetries are pervasive it is critical to have the capability of combining in a flexible manner financial and non-financial instruments, including the mechanism for strategic attraction of FDI. Nevertheless, there are advantages and also risks in combining all business development instruments under one umbrella. The advantage is the reduction of coordination effort, the possibility of tackling systemic failures and to have a more comprehensive strategic approach to business development and innovation. The risks are also significant - the institution will not have the level of specialization on the top management that it is required, since it would involve very different areas of knowledge: public policy on improving financial, equity and venture capital markets; SMEs support and extension mechanism, technology and R&D related matters, to policy for promoting accessing export markets, among others. Also there is the risk of political capture, which becomes higher given the power of the organization.

3.92. Lack of yardstick competition among agencies. Merging different organizational cultures sometimes becomes very problematic, therefore adjustment costs become important. Given the need to
have a quick implementation of the program for having a reasonable absorption of the resources one option is to keep separate the export promotion and attraction of foreign investment entity (Invest Bulgaria Agency) from the State Development Bank, that will undertake the financing responsibilities in the medium term, maintaining JEREMIE in the development of the equity and venture market in the short term and create a single agency for both SME’s technology absorption programs and business innovation.

I. Regional Dimension

a) Advantages and Pitfalls of Decentralization in Innovation

3.93. In the area of innovation decentralization remains a controversial issue even for large countries. The arguments in favor of decentralization are that regional governments may be better placed to identify opportunities and mobilize their knowledge bases because they are “close to the ground”. It also may promote a process of bottom-up self-discovery in a better way than national governments, or may promote a healthy competition among regions to stimulate aggregated innovation performance. Nevertheless, decentralization brings also many risks as wasteful duplications, fragmentation of public investments in R&D implemented separately and uncoordinated in different regions. Proliferation of public support programs can result in higher transaction costs, bureaucracy and complications for target firms. There is also very limited capacity to manage complex programs at a regional level (see Gimón, World Bank 2012).

b) International Experience

3.94. A review of the degree of decentralization in Science, Technology and Innovation among OECD countries shows that small countries with unitary government present low level of decentralization (see Table 3.4 below).

Table 3.4: Decentralization in STI policies across countries

<table>
<thead>
<tr>
<th>Degree of devolution in STI policy competences and resources</th>
<th>Federal countries</th>
<th>Countries with elected regional authorities</th>
<th>Countries with non-elected regional level</th>
</tr>
</thead>
<tbody>
<tr>
<td>High decentralization</td>
<td>Belgium, Germany, Switzerland, US</td>
<td>Italy, Spain</td>
<td></td>
</tr>
<tr>
<td>Some decentralization</td>
<td>Mexico</td>
<td>France, Netherlands, Poland</td>
<td>UK, Sweden, Korea</td>
</tr>
<tr>
<td>Low decentralization</td>
<td></td>
<td>Denmark, Slovakia, Turkey, Czech Rep.</td>
<td>Hungary, Ireland, Portugal, Greece, Finland, Slovenia</td>
</tr>
</tbody>
</table>
3.95. The case of Chile is an interesting example to consider. Figure 3.5 depicts the model proposed by the National Innovation Council. At the strategy level a National Innovation Strategy and Regional Innovation Strategies have been developed based on consultation process between the national and regional level. At the regional level there are Regional Productive Development Boards—public-private entities in charge of proposing regional development and innovation strategy for each region. Consultation process is essential in aligning the vision of development, linking national clusters with local development and regional clusters with national innovation system as well as identifying clusters that are relevant at a macro regional level. At the policy level dialogue between the Government’s Innovation Committee- in charge of innovation policy coordination and implementation-with the regional governments is facilitated through Contract Plans. Contract Plans play a role in consensus building process leading to an agreement on the strategic development of capabilities at the national, macro regional and regional level with both participation of sectors at the national level and in regions. This approach prevents the duplication of infrastructure and fosters the planning process.

Figure 3.5: Institutional Design in the case of Chile (Strategic, Policy Implementation, National and Regional level)

3.96. At the execution level the option is to develop some regional outreach capability of the national implementation agencies, at the same time keeping the allocation of projects at the national level. Only in SMEs’ programs for technology diffusion decision making on projects have been decentralized. Also the identification of groups of companies for road mapping is decentralized at the level of the regional
boards. Nevertheless, the decision on implementation of the roadmap is the result of national/regional agreements.

c) Proposal for Bulgaria

3.97. Bulgaria is a small open economy with unitary government and not elected regional authorities. The international benchmarking shows that decentralization efforts should be focused on adjusting at the strategic level to the needs and vision of the regions and fostering regional outreach of instruments to promote business innovation. Nevertheless, decision making for allocation of resources on science, technology, advance human capital formation and business innovation should be kept centralized. Yet technical assistance programs and financing schemes through financial intermediaries could become more decentralized.

3.98. Bulgaria could make progress in incorporating the needs of regions in the innovation agenda. As the national government develops the National Knowledge Innovation Board, at each of the six regions of Bulgaria an equivalent body should be developed expanding the scope to competitiveness strategy. The creation of Regional Innovation and Competitiveness Councils with the participation of regional authorities, local governments, business and academia could play an important role in promoting the regional agenda of innovation. The Councils should have the responsibility of defining competitiveness and innovation strategies. The purpose of that exercise would be to identify sectors in which the region has latent, comparative advantages and the main gaps for the development of the sectors. The councils should have some executive capacities and promote competitiveness and technology road mapping in groups of companies or regional clusters. The goal would be to define a bottom up process for identifying the bottlenecks for the growth of sectors with high potential. Based on results of this process the regional and local governments should have the ability to bring the attention of the national level, to remove the factors that prevent the development of key activities. Also some problems could be solved at a regional or local level.

3.99. The creation of technological and scientific infrastructure in regions should also follow a smart specialization approach and be consistent with the requirements of the productive fiber and resources of the regions. Keeping always in mind the need to develop critical mass; the process of identifying strategic creation of capabilities in science, technology and advance human capital could become the cornerstone of contract plans based on a systemic approach and considering the needs of key clusters.

3.100. It is very likely that most of mission oriented science would be concentrated in large cities and major universities. Nevertheless, technology centers and incubators and superior education capabilities at technological and university level could be developed more widely.

3.101. Regional and multi-regional clusters should be able to participate in technology consortia projects. One of the main outcomes of bottom-up originated technology road mapping is to serve as the basis for structuring technology consortia among university centers, technology centers and businesses ensuring participation of all relevant stakeholders. Moreover, grants for business innovation should be
promoted at the regional level as well as in alliances for advising the firms on the application process should be established in regions. Yet, the evaluation and allocation of resources should remain centralized.
Chapter 4. Research

A. Introduction

4.1. In the next seven years, with support from EC Structural Funds, Bulgaria has an unparalleled opportunity to upgrade its research base and transform itself into a knowledge-based and R&D-led economy. This chapter assesses the challenges facing Bulgaria’s research system, and recommends ways to strengthen the effectiveness and impact of that system as part of the Smart Specialization Strategy. The chapter proposes pragmatic short and medium-term interventions that can boost the results obtained from today’s research system and recommends strategic long-term options for furthering that agenda through a comprehensive reorganization of the system.

4.2. Bulgaria’s research base could generate huge economic, social, and environmental benefits. But to realize this potential, the policy and funding decisions need to take into account that the desired outcomes are not only a product of research inputs and outputs, but require linkages and feedback loops that enable users to diffuse, adopt and translate these outputs (Figure 4.1: Tracing the Impact of the Research System – from Research Inputs to Outcomes) presents inputs, outputs, and outcomes of a research system). Domestic benefits will remain small if researchers operate in silos, if institutions specialize in fields that are detached from the local demand for cutting-edge knowledge, if there is a weak culture of entrepreneurship, or if there is uncertainty about the protection of intellectual property (IP).

![Figure 4.1: Tracing the Impact of the Research System – from Research Inputs to Outcomes](image)

4.3. Turning Bulgaria’s research system into a real engine of innovation and smart specialization presents serious challenges. One of those challenges will be to increase the research funding envelope in a constrained fiscal environment, but this is essential to make up for the chronic underfunding since 1990. The Government of Bulgaria has adopted a national R&D investment target of 1.5 percent of GDP.
by 2020. Increasing the national budget for research and launching the proposed Operational Programme “Science and Education” are critical actions that can help to attain this target. For the extra funding to have a transformational impact, the financing mechanisms will need to be redesigned, and this presents a challenge in terms of the capacity of the public sector to administer competitive funds in an efficient and transparent way. There are also multiple legacy issues that need to be tackled head on, particularly the way in which research and teaching have been organized at the institutional level, dysfunctional incentive systems within research organizations, and the scientific community’s lack of trust in the private sector and IP.

4.4. This chapter begins by discussing the rationale for a country like Bulgaria to strengthen its research system. It then benchmarks the research performance against relevant countries and presents a diagnosis and recommendations focused on five areas: (a) how to improve the organization of the system, including a proposal about how to manage the restructuring of the Bulgarian Academy of Science (BAS) institutes and universities; (b) designing mechanisms to channel public funds more efficiently and with more impact, which is relevant in view of the future injection of EC funds; (c) areas where policy and program implementation need to be strengthened, with a focus on the National Science Fund; (d) changes in the academic career system to make scientific careers attractive again; and (e) measures to stimulate commercialization of research and the economic impact of innovation.

B. The role of scientific research in the Smart Specialization Strategy of emerging countries

4.5. This section discusses the benefits of scientific research as a critical element of Bulgaria’s Smart Specialization Strategy. It discusses the inter-linkages between scientific research and innovation, and the rationale for emerging countries such as Bulgaria to make public investments in research to increase their global competitiveness.

The place of scientific research in the innovation ecosystem

4.6. Scientific-based innovation is important from a growth and social perspective. Science is constantly moving the technological frontier forward, through “fundamental scientific discoveries that entirely change the sets of tools for human improvement, create new platforms for technology, such as the genetic revolution and the consequent development of biotechnologies for improving health and agriculture.”51 Scientific research is also central for building a country’s innovative capacity and absorptive capacity, which allows countries to catch-up more rapidly.52

51Conway, Waage, Delaney (2010), Science and Innovation for Development. UK Collaborative on Development Sciences (UKCDS), 2010
4.7. Research systems involve different actors and institutions. The government has a critical role when it comes to financing basic research because scientific knowledge becomes a “public good” after it is disseminated in journals and conferences – which means that private sector will invest less than is socially optimal. The bulk of internationally recognized research around the world is carried out in universities that combine teaching with research, although public entities like the National Laboratories in the US continue to play an important role. Entrepreneurs and companies play the main role in translating scientific research into profitable inventions and taking them to the market – without private R&D, business investment and marketing, inventions such as penicillin, computers and ICT technologies would not have been invented or would have experienced much slower diffusion. Last but not least, users of new technologies are frequently involved in testing, reviewing, reconfiguring and developing new improvements.
In order to prepare the ground for further discussion, it’s important to define the following terms:

- **Science** is the process of generating knowledge based on evidence. Fields of science include both natural sciences and engineering (biology, chemistry, physics, mathematics and related disciplines) and social sciences (economics, sociology, anthropology, politics, and law) [1].

- **Research and experimental development (R&D)** comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications. [2]

- **An innovation** is the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. [3]

**R&D – the main pathway to innovation – is in reality a sequence of interconnected activities that includes basic research, applied research, mission-oriented research, and experimental development:**

- **Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view. Most basic research is performed in universities and in public research organizations (PROs); therefore, the public support is crucial.

- **Applied research** is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective. Applied research is more likely to involve industrial partners. Public-private collaboration is essential in applied and business R&D.

- **Mission-oriented research** involves basic and applied research with the goal to address major challenges. The approach usually involves tapping into global knowledge complemented with country’s own R&D. Mission-oriented research can be driven either by national priorities such as health, environment, or defense, or by the competitive challenges faced by key business segments or clusters.

- **Experimental development** draws on existing knowledge gained from research and/or practical experience to systematically develop new materials, products, or devices; install new processes, systems, and services; or substantially improve those already produced or installed. Experimental R&D can be performed by formal R&D units, or informally by entrepreneurs and others [2].

**Sources:**

4.8. To realize the full benefits from the research system, new results need to be commercialized in some way. Knowledge transfer can be separated into “supply-push” when knowledge generated inside the research system is commercialized through IPR, technology transfer and spin-offs; and “demand-pull” when companies get support from researchers through contract research and collaborative (See Figure 4.2).
Global trends in science and what they mean for emerging countries

4.9. The pace of knowledge creation is accelerating and the scientific frontier is rapidly shifting. This creates competitive pressure; in fact, competition has become so intense that countries need to invest and move forward just to remain in the same relative position. Countries like Bulgaria need a vibrant and internationally well connected research system in order to absorb and benefit economically from the knowledge developed worldwide.

4.10. The EU is a global leader in scientific research, which has given a huge advantage to Bulgaria and other new member states in Central and Eastern Europe over middle-income countries in other regions. However, there are signs that the continent is slipping behind and this implies that Bulgaria’s scientists need to think globally about what institutions to partner with. The United States leapfrogged ahead of Europe in the 20th century, and emerging countries like China have closed the gap and are leading in many areas. Like other assessments, the Innovation Union Competitiveness Report 2011 concludes that “the EU’s Research and Innovation (R&I) remains relatively competitive, even in a changing multi-polar world the EU remains the second major R&I center after the United States of America, but in many areas, the EU is still behind its main world competitors and its overall competitive position is declining” (Figure 4.3).
4.11. Scientific research has become increasingly multidisciplinary at the global level. (Figure 4.4) evidences the enormous complexity and cross-disciplinary character of current scientific research. Fields such as mathematics are so interwoven throughout the research system that they have no single label.\textsuperscript{53} One of the repercussions is that innovation often occurs at the margin or intersection of disciplines. To benefit from this trend, Bulgaria also needs to intensify the interactions between scientists working in different fields.

4.12. Many emerging countries have introduced institutional reforms to align the incentive systems inside universities and PROs with those of advanced knowledge economies. This has led to changes in hiring practices, decreased opportunities for newer cohorts to engage in research, especially research directed by themselves, changes in the availability of materials and databases used in research, changes in the peer learning environment, changes in publication practices, and increased expectations from the public regarding what the university can contribute to economic development. Bulgaria’s research system will also need to move in this direction.

4.13. To appropriate more benefits from its research, countries of all income levels are moving towards a targeted approach that emphasizes mission-oriented research. Large developed economies like the US and Germany can follow a ‘science-push’ approach, but emerging countries like Bulgaria need to concentrate their scarce resources on a mission-oriented agenda that is pertinent for the country and can solve national problems linked to health, transport, defense and environment. Enhancing productivity in major economic sectors by stimulating domestic companies to engage in technology transfer, reverse

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engineering and technology adaptation goes hand in hand with the mission-oriented research that the country undertakes.

4.14. Although mission-oriented research can yield more immediate results, successful knowledge economies like Finland and Israel have continued to nurture a core of high-quality basic research. Basic research can generate important long-term benefits, because it: (i) makes academic careers more attractive, especially in countries that face a brain drain; (ii) facilitates the connection of the local research community with international world class research groups; (iii) provides a basis for the formation of advanced human capital; (iv) finally can lead to a deeper understanding of the basic science behind technology developments that are being pursued.

C. Global Benchmarking of Bulgaria on key science and research indicators

4.15. This section benchmarks Bulgaria’s scientific research against the rest of the world. Starting with the Knowledge Economy Index (KEI), which gives a panoramic view, the benchmarking covers key indicators related to scientific productivity, the mix of basic and applied research, the strength of specific scientific fields, internationalization and integration into the European Research Area (ERA) and commercialization of research. Overall, the indicators reviewed suggest that the country’s scientific capacities have stagnated over the last twenty year period, with substantial declines in applied research and commercialization of research.
4.16. The Knowledge Economy Index (KEI) suggests that Bulgaria has struggled to maintain its global position on R&D indicators in the post-1990 period. The Knowledge Assessment Methodology (KAM) consists of 148 structural and qualitative variables in the following pillars: Economic Incentive and Institutional Regime, Education, Innovation, and Information and Communications Technologies (ICT). For details see: http://siteresources.worldbank.org/INTUNIKAM/Resources/2012.pdf.

4.17. The size of Bulgaria’s research system is in line with the country’s level of income, as measured by the number of researchers per capita. Bulgaria’s pool of researchers has contracted over the last decade, but as the population fell during this period, the number of researchers per capita has remained approximately stable. The number of researchers is just above what would be expected given the country’s income levels and global trends (Figure 4.7). However, if the contraction in the number of researchers continues, the research system will become “too small”, in contrast with other Central and Eastern countries in the EU, which have increased science funding as GDP increased.

Figure 4.7: Researchers per capita in Bulgaria and selected countries (2000-2011)

Note: The figure shows the annual 2000-2011 observations for Bulgaria, EU comparison countries, OECD and emerging countries. The trend line shows that there is a positive nonlinear relationship between the number of researchers per capita and GDP per capita; the grey shaded area is the 95% interval around this trend line.

4.18. Scientific productivity as measured by the volume of publications improved slightly during the Lisbon Agenda period (2000-2010), but it still fell behind relative to neighboring countries, the EU, and global leaders. By 2011, the number of published articles in ranked journals reached 0.43 per 1,000 of
population, ahead of Poland with 0.39 per 1,000 (). While other countries experienced a jump in scientific output in line with or above their economic growth trends, Bulgaria did not.

Figure 4.8: Scientific production in Bulgaria and selected countries (1996-2011)

4.19. The quality of research as measured by citations to scientific papers written by Bulgarian scientists is lagging behind. Bulgaria is comparable to countries in Central and Eastern Europe in terms of citations, but far below Italy, Finland, and the EU as a whole. Similar results emerge through the lens of the H-index. Bulgaria’s H index is 129, meaning that in the 15-year timeframe between 1996 and 2011 only 129 publications generated at least 129 citations, which is far below other EU countries. This suggests that only a small share of research produced in Bulgaria has a significant impact in terms of knowledge creation and diffusion:

Table 4.1: Scientific publications and citation totals, 1996-2011

<table>
<thead>
<tr>
<th>Country</th>
<th>Citable documents</th>
<th>Citations</th>
<th>Citations per Document</th>
<th>H index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>803,004</td>
<td>11,279,167</td>
<td>15</td>
<td>550</td>
</tr>
<tr>
<td>Poland</td>
<td>297,361</td>
<td>2,149,143</td>
<td>8.13</td>
<td>281</td>
</tr>
<tr>
<td>Finland</td>
<td>165,195</td>
<td>2,771,982</td>
<td>18.28</td>
<td>352</td>
</tr>
<tr>
<td>Hungary</td>
<td>96,842</td>
<td>1,058,391</td>
<td>11.57</td>
<td>239</td>
</tr>
<tr>
<td>Romania</td>
<td>75,381</td>
<td>338,601</td>
<td>6.31</td>
<td>126</td>
</tr>
</tbody>
</table>

The index, developed by Jorge E. Hirsch, equals $h$ if a country publishes $h$ papers each of which has been cited by others at least $h$ times in the considered time frame. This index does not weight the number of coauthors involved or the composition of the scientific portfolio of countries and differences in terms of citing propensity between fields.
4.20. Bulgaria’s research system is mainly oriented towards basic research, with scarce results from mission-oriented and applied research activities. Compared to other countries, basic research outputs such as academic publications greatly outnumber applied research outputs such as patents, licensing, spin-offs and the like (Table 4.2: Basic Research vs. Applied Research ratio, 2010). The ratio of published articles to patents is one indicator of the mix of basic to applied research outputs: in Bulgaria this ratio is 281:1, about seven times what the ratio is in Hungary and twenty times what it is in Finland. As the next section discusses, it is important to put in place a system that also encourages mission-oriented and applied research.

Table 4.2: Basic Research vs. Applied Research ratio, 2010

<table>
<thead>
<tr>
<th></th>
<th>Published Articles in Academic Journals, 2010</th>
<th>Patent applications to the EPO, 2010</th>
<th>Ratio of published articles per patent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgaria</td>
<td>3423</td>
<td>12.2</td>
<td>281:1</td>
</tr>
<tr>
<td>Hungary</td>
<td>8083</td>
<td>202.97</td>
<td>40:1</td>
</tr>
<tr>
<td>Finland</td>
<td>14289</td>
<td>1166.88</td>
<td>12:1</td>
</tr>
</tbody>
</table>


4.21. The country’s scientific specialization did not change significantly over time, as measured by publications in individual scientific fields from the point of view of research outputs, the largest share of Bulgaria’s published scientific work between 2001 and 2012 was in physics and astronomy, followed by medicine, chemistry, biochemistry, and material sciences, the same fields as twenty years ago. The R&D by field shows increasing resources deployed towards medical and health sciences, whereas funding for agriculture research has dropped (See ANNEX 4.1). The While the public R&D allocated to each field can vary from year to year the majority of this goes to pay for researcher salaries, leaving negligible amounts to nurture research in new areas. This leads to a continuation of research agendas, with weak responses to demand-side changes.

4.22. Bulgaria’s research system has deepened its international collaborations. Almost 50 percent of all published articles are produced with researchers from other countries (see Figure 4.9). Bulgarian researchers are thereby involved in about 3 percent of the total publications for the Eastern Europe region. In terms of international co-publications, Bulgaria is behind Finland among the comparison

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57 2012 data includes a range January 1, 2012 - December 7, 2012.
58 According to SCImago, Eastern Europe region encompasses 23 countries, listed online: http://www.scimagojr.com/countrysearch.php?region=Eastern Europe (Bouvet Island is excluded)
group and ahead of Hungary and Romania in 2011 (Figure 4.9: Percentage of Published Documents with More than one Country). Importantly, Bulgaria’s main partners are increasingly from high-performing countries in the European Research Area (ERA): Germany, USA, France and Italy. By taking advantage of the proximity to excellent European institutions, Bulgarian researchers work on projects which have better visibility in the scientific community and refocus their research agenda towards questions that are at the frontiers of science.

Figure 4.9: Percentage of Published Documents with More than one Country

Source: SCImago based on SCOPUS, December 2012

4.23. Commercialization of research is a weakness of Bulgaria’s research system, with poor results across all standard indicators. As shown in Figure 4.10, Bulgaria earns almost no receipts from royalties and license fee payments and, according to data collected by the WEF GCR, it is behind in terms of the system to protect intellectual property and the degree of university-industry collaborations. Almost no

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According to the Erawatch, “the Ministry of Education and Science has signed bilateral agreements with 13 countries. For the period 2002-2008, Bulgaria has implemented 52 science and technology projects in collaboration with India, 30 with China, 26 with Macedonia 20 with Vietnam and 17 with Ukraine (MES data). The Bulgarian Academy of Sciences has also concluded 37 bilateral agreements, including seven countries outside Europe.”

Royalty and License Fees Receipts are receipts between residents and nonresidents for the authorized use of intangible, non-produced, non-financial assets and proprietary rights (such as patents, copyrights, trademarks, industrial processes, and franchises) and for the use, through licensing agreements, of produced originals of prototypes (such as manuscripts and films). Source: IMF, Balance of Payments Statistics Yearbook and data files.

Intellectual Property Protection is based on the statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether intellectual property protection is strong in their country (1 = weak or nonexistent, 7 = is equal to the world's most stringent). University-Company Research Collaborationis
EPO or USPTO patents have been granted to researchers working in PROs. According to USPTO statistics, only five patents have been granted to Bulgarians working for universities abroad over the past 10 years, and none to scientists working for universities in Bulgaria. While young people are creating high-tech enterprises, they are not connected to the research institutions and universities and as a result there are no documented examples of spin-offs from PROs that have grown to become medium or large companies.

Figure 4.10: Bulgaria’s research commercialization indicators (normalized) vis-à-vis other countries


D. Diagnosis of the institutional and funding challenges facing Bulgaria’s research system

4.24. This section provides a diagnosis about the institutional and funding challenges faced by Bulgaria’s research system. The weaknesses faced by the research system in 1990 have become more acute as a result of the poorly organized PROs, chronic underfunding, weak incentive systems for excellence and commercialization of research results, continued brain drain and a disconnect between the public research system and the enterprise sector. In this context, there is a need to identify areas where short-term improvements are feasible and those where reforms will take time due to structural problems.

Based on the statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether companies' collaboration with local universities in research and development activities in their country is (1= minimal or nonexistent, 7= intensive and ongoing). Source: WEF Global Competitiveness Report 2010.
Organization of the research system

4.25. According to the available assessments\(^6\) and an in-depth analysis of the publication track record (bibliometric analysis), only a small number of PROs are engaged in research that meets international standards (Table 4.3: Top Bulgarian Institutions in Terms of Publications (1981-2009)):

- **The top institutes of the BAS continue to lead basic research in many fields.** According to the 2009 ESF-ALLEA peer evaluation, 16 of the 69 institutes are internationally competitive, 35 have some international visibility, while the rest have, at most, national visibility.\(^6\) Overall, BAS institutes account for about 50 percent of Bulgaria’s scientific production in terms of publications. The dominant role of BAS in scientific research reflects its history as the country’s main research institution and owner of the bulk of the public research infrastructure.

- **The largest universities in Sofia are also active in high-quality basic research.** The most prominent universities account for one quarter of Bulgaria’s ranked publications over the last 10 years. These universities are Sofia University “St. Kliment Ohridski” (13 percent), the Medical University Sofia (5 percent), the University of Chemical Technologies and Metallurgy (4 percent) and the Medical Academy Sofia (3 percent).

\[ \text{Table 4.3: Top Bulgarian Institutions in Terms of Publications (1981-2009)} \]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Total</td>
<td>%</td>
</tr>
<tr>
<td>Bulgarian Academy Science</td>
<td>1</td>
<td>7,977</td>
<td>53.76</td>
</tr>
<tr>
<td>University of Sofia</td>
<td>2</td>
<td>2,062</td>
<td>13.90</td>
</tr>
<tr>
<td>Medical University Sofia</td>
<td>3</td>
<td>1,058</td>
<td>7.13</td>
</tr>
<tr>
<td>Univ. Chem. Tech. &amp; Metallurgy</td>
<td>4</td>
<td>514</td>
<td>3.46</td>
</tr>
<tr>
<td>Medical Academy Sofia</td>
<td>7</td>
<td>156</td>
<td>1.05</td>
</tr>
<tr>
<td>Total - ALL FIELDS</td>
<td></td>
<td>14,839</td>
<td></td>
</tr>
</tbody>
</table>


4.26. The remaining BAS institutes and universities fail to produce research that is internationally relevant, which in turns limits their access to competitive research funds. More than three-quarters percent

\(^6\) European Science Foundation (ESF) and ALLEA (All European Academies), *Research at the Bulgarian Academy of Sciences*, in five volumes, 2009.

\(^6\) The top institutes are: the Institute of Mathematics and Informatics; the Institute for Nuclear Research and Nuclear Energy; the Institute of Electrochemistry and Energy Systems; the Institute of Polymers; the Central Laboratory of Photo processes; the Institute of Molecular Biology; the Institute of Neurobiology; the Institute of Biophysics; the Institute of Plant Physiology; the Stephan Angeloff Institute of Microbiology; the National Institute of Meteorology and Hydrology; the Geophysical Institute; the Institute of Oceanology; the Central Laboratory of Mineralogy and Crystallography; and National Institute of Archaeology with Museum; and the Cyrillic-Methodian Research Centre.
of the active higher education institutions are not producing research at EU levels of excellence and correspond to what in the US are called “teaching universities”.

4.27. Bulgaria’s research system remains highly concentrated in institutional and geographic terms. Almost all high-quality research takes place in Sofia. The top five institutions—all of which are in Sofia—produce about three quarters of the country’s total publications (Table 4.3: Top Bulgarian Institutions in Terms of Publications (1981-2009)). According to the register of the Ministry of Education and Science (MES), Bulgaria has 51 accredited higher education institutions (HEI),64 of which 71.1 percent are located in three cities – Sofia (44.2 percent), Plovdiv (17.3 percent), and Varna (9.6 percent) (see Box 4.2).

Box 4.2: Bulgarian Academy of Science in-depth - Looking Back and Ahead

**Between 2007 and 2012, scientific research activities in BAS experienced a U-turn.** The number of publications (not just ranked journal articles but also monographs and other national publications) reached 11,632 for 2008[1] but since then the numbers have shown a decline: 11,367, 10295, 10051 for 2009, 2010 and 2011 respectively.[2,3,4] The average publication activity of a BAS scientist increased from 3.05 publications per researcher in 2007 to 3.19 in 2008 to 3.27 in 2009, but decreased thereafter. The budget cuts have affected public research, and the difficult economic environment made it increasingly difficult to sign research contracts or provide technology services to the private sector.

**In 2008, based on the ESF-ALLEA evaluation, the BAS started a reorganization that aimed to improve the institutes’ scientific productivity.** The academy’s 72 institutes have been merged into 42 institutes, and new procedures for periodic institutional attestation of research institutes and scientists were prepared and approved. Nine thematic panels and advisory bodies were also established to improve the overall governance of the institutions. The results of the reorganization are not yet visible and will be hard to assess, as the decline in scientific production is likely to be a result of the sharp reduction in institutional and project funding.

Additional funding of projects and contracts for the period 2002–2011 (in BGN) [4]

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>34,827</td>
<td>32,963</td>
<td>38,832</td>
<td>35,370</td>
<td>35,520</td>
<td>36,071</td>
<td>36,031</td>
<td>35,434</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>34,827</td>
<td>32,963</td>
<td>38,832</td>
<td>35,370</td>
<td>35,520</td>
<td>36,071</td>
<td>36,031</td>
<td>35,434</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The distribution over innovative groups for BAS 2008-2011[4]

<table>
<thead>
<tr>
<th>Year</th>
<th>IR</th>
<th>ID</th>
<th>IT</th>
<th>IM</th>
<th>IP</th>
<th>IBDR</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>1135</td>
<td>205</td>
<td>96</td>
<td>96</td>
<td>37</td>
<td>63</td>
<td>1982</td>
</tr>
<tr>
<td>2009</td>
<td>1933</td>
<td>205</td>
<td>44</td>
<td>56</td>
<td>24</td>
<td>27</td>
<td>1299</td>
</tr>
<tr>
<td>2010</td>
<td>724</td>
<td>195</td>
<td>43</td>
<td>24</td>
<td>23</td>
<td>27</td>
<td>1029</td>
</tr>
<tr>
<td>2011</td>
<td>812</td>
<td>95</td>
<td>19</td>
<td>26</td>
<td>14</td>
<td>18</td>
<td>1054</td>
</tr>
<tr>
<td>Average number</td>
<td>770</td>
<td>221</td>
<td>43</td>
<td>50</td>
<td>25</td>
<td>36</td>
<td>1031</td>
</tr>
</tbody>
</table>

64http://www.mon.bg/left_menuregistersvishe/registar.html.
BAS projects are focused on basic and early stage applied research. As in previous years, in 2011 the research and development phase (iR and iD) accounted for over 80 percent of the innovation activities, almost 10 times more than the number of mature and more application-oriented innovation activities including iT (technology transfer), iM (developments with high maturity) and iBDR (business-driven). See table below for details. Patenting data confirms these trends. The economic downturn contributed to the decline of market-oriented innovation activities; however the trend shows a major issue in translating research and development into market-oriented products and services.

**Sources:**

4.28. The research capacity inside the universities is being monitored through the Bulgarian University Ranking System (BURLS). The rankings confirm the findings of the bibliometric analysis: Sofia University "St. Kliment Ohridski" ranks first in terms of the average score across disciplines, followed by the Technical University of Sofia and the University of Chemical Technology and Metallurgy. Sofia University and the Technical University of Sofia have the highest scores in disciplines related to industries concentrated in Sofia (e.g., ICT, machinery and electronics). The rankings also reveal pockets of research excellence in applied fields in universities located outside of Sofia. For industries that are regionally dispersed, local universities have a better score in research and science.

4.29. An analysis of the relationship between teaching and research in BURLS, categorizing the disciplines into sector-related fields, indicates that teaching and research outcomes are weakly correlated. There is a strong positive correlation between teaching and research in the pharmaceutical field. The correlation between teaching and research is relatively strong yet negative in food processing. In ICT, the correlation is weak and there is no correlation in fields related to machinery and electronics.

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65 This ranking was developed to help education users in their choice of a university. It was updated in 2012 and currently it lists 51 accredited universities in Bulgaria which offer education in 52 professional fields. The detailed ranking results are included in ANNEX 4.2.
The disconnect between research and teaching at the institutional level is a legacy of the system prior to 1990 that continues to have a number of negative effects. It deprives undergraduate and graduate students of the benefits of early exposure to top-level research which could bring research findings and research tools into the classrooms and ensure student participation in research projects. While the BAS plays a predominant role in research, it did not have a role in teaching until recently, and many universities have yet to develop a critical mass of research in any discipline.

### Public funding for research

There are several channels for public funding to reach Bulgaria’s researchers. National budgetary funding for science is provided to: (a) the Bulgarian Academy of Sciences and accredited public universities; (b) line ministries that are responsible for specialized PROs (the Agricultural Academy and the National Centre of Public Health Protection) and the Ministry of Defense for defense-related research; (c) MES for project funding awarded channeled through the National Science Fund (NSF).

Compared to EU and emerging countries, research funding is low and is allocated mainly through institutional funding instead of competitive funding streams. Bulgaria’s public R&D expenditure is about 35 percent of the EU27 level. The current level of institutional funding only covers basic expenses such as research salaries. At the same time, project funding managed by NSF dropped in the last three years due to the austerity measures and as a result there have been no regular calls for proposals. Figure 4.12

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66Erawatch Country Report Bulgaria 2011
provides an assessment of the funding issues in universities; a breakdown of the income and expenses at the BAS is available in their annual reports. Diversification to competition-based financing mechanisms would be highly beneficial to incentivize research excellence and achieve the 2020 targets.67

4.33. In addition to the weak funding envelope, the share of public R&D channeled to the higher education sector is well below EU levels.68 Public R&D funding going to universities was only 12 percent of the EU27 level in 2011, the lowest among the comparator countries (Figure 4.13). This is a reflection of how the research system is organized and the fact that BAS absorbs a large share of the science budget.

4.34. Bringing research funding for higher education up to European levels would reinforce the overall research system. The government’s policy in the last four years has been to channel additional funds to universities to increase their research capacity while improving the accreditation and quality systems. However, the amount of funding is low relative to hiring and infrastructure needs, and needs to be increased significantly to have a real effect. This effect would be amplified if significant resources were

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68 Public R&D is the sum of government and higher education sectors R&D expenditure
directed to research infrastructure and collaborative research projects that are jointly executed by BAS institutes, top universities, and teaching universities.

4.35. There is a growing volume of international funding, primarily coming from the EU Framework Programmes. A growing share of R&D funding in Bulgaria came from the European Framework Programme for Research (FP7) and the Competitiveness and Innovation Framework Programme (CIP). But the additional funding that Bulgaria’s researchers can obtain under these programs will be limited because of the intense competition for resources from all institutions in Europe, particularly given the reduction in science budgets in many countries. Within the FP7, Bulgarian projects accounted for only 0.22 percent of all funded projects in the period 2007-2011, whereas the share of Bulgaria’s GDP to EU GDP is 0.59 percent.

4.36. While limited up to now, some funding for research was also available from EU Structural and Cohesion Funds through (a) OP Competitiveness priority axis 1, which supports private-public R&D and technology transfer; and (b) OP Human Resources, which supports training. The proposed OP on Science and Education 2014-2020 would transform the funding environment, as EU funding for research in Bulgaria would overtake the national funding that is available. The recommendations section provides suggestions about what to prioritize in this new OP.

Implementation of scientific support instruments

4.37. The National Science Fund (NSF) is the main source of competitive research funds in Bulgaria and it has a critical role to play in designing and evaluating science funding. However, the poor implementation track record has undermined the credibility of the NSF in the scientific community. Before the NSF can be given the responsibility of implementing EU funds under the future OP for Science and Education, it is critical that it has the right level of capacity, transparency and accountability.

The NSF budget and instruments

4.38. The national programs to support basic and applied research that are implemented through the NSF have shrunk as a result of budget cuts and implementation problems. At its peak in 2009, the NSF had a budget of 80 million BGN. After the fiscal consolidation, this budget dropped, and no new projects were funded in 2010, and in 2012 the NSF made grants totaling only 14 million BGN. Since 2008, 6,000 researchers participated in NSF-funded project. Most applicants are from the Bulgarian Academy and state universities.⁶⁹

⁶⁹NPR 2011-2015
4.39. The NSF channels most of its resources through competitions that vary by scientific area. The NSF supports four main categories of projects: (a) projects related to building research infrastructure; (b) projects supporting young scientists; (c) experimental research projects, many of which are interdisciplinary; e.g., a project to make a digital map of an ancient city involves architects, archeologists, programmers, and digitalization; and (d) projects aimed at reintegrating researchers from the Bulgarian diaspora.

4.40. The funding instruments deployed by the NSF have a number of shortcomings. First, the instruments have not been updated to take account of the new strategies and policies that have been approved in Bulgaria and the EU and they are not connected to the instruments supporting business innovation. Second, the instruments have aimed to disperse resources widely through the research system, rather than build a critical mass of research that is recognized internationally. Third, the instruments provide limited programmatic funding, which is needed to carry out larger multi-annual research programs and strengthen the underlying research infrastructure. Fourth, the criteria for evaluating the projects ex ante are not aligned with international good practices, which underline excellence and research commercialization.

**NSF governance**

4.41. The Fund is managed by a director appointed by the Minister of Education and Science with a board composed of Bulgarian researchers and a dedicated staff. It operates the competitions with a number of standing and interim Expert Panels (EPIs), also appointed by MES. The members of these panels are Bulgarian scholars nominated by the scientific institutes and universities. Six expert committees (ECs) at the NSF reflect scientific priorities: mathematics and informatics, natural sciences, biological and medical sciences, agricultural sciences, technical sciences, and social sciences and humanities. Standing committees decide on the distribution of funds to the selected projects in accordance with the rules set out in the Law on Scientific Research Promotion and the statutes of the NSF.

4.42. The governance of the NSF has proven inadequate in several ways. The overarching governance issues of the research and innovation system are discussed in Chapter 3. With regards to the NSF, the key issues are that: (a) past NSF directors have usually been senior academics with limited management experience; (b) the expert panels do not count with sufficient independent international reviewers, which has led to complaints about conflicts of interest, and these have intensified as the NSF funding declined and competition among institutions and research projects became more intense; (c) the NSF does not have an adequate M&E framework, which has led to questions about the public efficiency of research funding. The resignation of several NSF directors in the last five years in the face of researcher protests is a symptom of the underlying governance problems at the agency.
**NSF project evaluation**

4.43. According to the internal statutes, each supported project is monitored by an 11-member evaluation committee. During implementation, the evaluation committee collects information on their progress. The projects run for 24 to 36 months. Some projects continue to be monitored after completion, particularly if they are likely to lead to a patent or involve a substantial innovation.

4.44. There are weaknesses in both ex ante and ex post project evaluation and consequently there is no systematic data about the project results. An international assessment carried out in 2006 identified several weaknesses that affect the project selection process, particularly regarding the profile of evaluators, and the absence of a robust M&E system. Most of these weaknesses have yet to be corrected. In addition, there has been no impact evaluation or ex post assessment of the competitions funded under the recent calls for proposals.

4.45. The evaluations at Tekes, the Finnish Funding Agency for Technology and Innovation, are a good practice example in the EU that shows why it is important to carry out periodic evaluations at the NSF and how to do this. The evaluations at Tekes have been used to measure different aspects of the funding impact framework (Figure 4.14) as well as to identify problems in the way that the agency and its programs are designed and implemented:

- **Measuring the economic and social impact**: (i) The projects funded by Tekes that were completed in 2011 resulted in 470 new or improved products, 400 new or improved services, 280 new or improved processes, 840 patent applications, 1,020 academic theses; (ii) Tekes has participated in the funding of more than 60 percent of well-known Finnish innovations and in 94 percent of the innovations that are based on scientific breakthroughs; (iii) Two out of three Finnish innovations based on public research have received funding from Tekes; (iv) For every euro invested by Tekes, companies increase their total R&D expenditure by two euros; (v) Companies doing Tekes-funded R&D invest more of their own money in R&D than those without Tekes funding.

- **Corrective actions taken in Tekes as a result of the evaluations**: (i) Tekes introduced an electronic process for handling the funding applications; (ii) As a result of earlier evaluations and changes in the operational environment, Tekes completely renewed its strategy in 2011; (iii) Since previous evaluation, in order to reorganize and refocus its role in the Finnish economy Tekes renewed sectors and segmentation of customers reflected in 2011 strategy; (iv) Tekes shifted the emphasis on financing start-ups and innovative high-growth SMEs.

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72 Ibid.
Academic careers

4.46. The additional income that young people receive in Bulgaria by obtaining an advanced educational degree is not competitive relative to the EU. Data on annual earnings by educational attainment indicate that PhD graduates in Bulgaria earn less than in all other EU countries except Romania, and do not get a large earnings premium compared to university or masters graduates (Figure 4.15). This is a disincentive for young people to start a PhD. It also makes Bulgarian doctorate holders much more dissatisfied with their salary (Figure 4.16).
4.47. The data available suggests that PhD holders earn a modest premium when they work in research, but this premium is mainly going to researchers in the private sector. According to the latest OECD Science, Technology and Industry Scoreboard (2011, based on 2009 data), Bulgaria has nearly a 15 percent average earning differential between doctorate holders working as researchers (including those working at universities) and those not working as researchers. PhD holders working as researchers earn almost 30 percent more than non-researchers when employed in the business enterprise sector, and 9 percent more when employed in the higher education sector. They earn 7 percent less than non-researchers if employed in the government sector (See Annex 4.4).

4.48. The salaries of researchers employed in Bulgaria’s PROs are the lowest in the EU. According to comprehensive surveys of researchers in the EU, as well as more recent data collected in online databases, salaries of Bulgarian scientists are well below those in every other EU country, including neighboring Romania (Figure 4.17)

Figure 4.15: Annual Earnings Based on Education Attainment in Euro, 2010

Figure 4.16: Level of dissatisfaction of employed doctorate holders by reason (salary) (%), 2009


Figure 4.17: Total Annual Average Salary of researchers (2006, all currencies in EURO and in terms of PPS)
Source: EC Research Directorate (2007), Remuneration of Researchers in the Public and Private sectors, April 2007. Note: The EC Research Directorate (2007) study analyses the average remunerations of researchers per country by normalizing results in terms of the Purchasing Power Standard (PPS). PPS is based on the cost of living per country, allowing multilateral comparison not only within the EU, but also at the international level.

4.49. Besides the problem of unattractive salaries, the current promotion systems and the competitive funding instruments do not prioritize the careers and projects of young researchers. The PROs lack a tenure and promotion system whereby younger researchers are provided with long-term employment contracts and research grants if they can demonstrate their potential through international publications. This demotivates scientists, makes it difficult to recruit young people into research careers, pushes researchers to supplement their income with other activities, and makes it difficult for the PROs to enter into new research areas.

4.50. As a result of the earnings gap and the limited career opportunities, talented young researchers are migrating to other EU countries or the United States. This loss of vital talent is one of the most pressing problems in Bulgaria’s research space, and is one of the factors accelerating the ageing of the research community (Box 4.3). In the most recent WEF Global Competitiveness Report 2012-2013 (WEF GCR), Bulgaria ranks among the countries in the world with the highest brain drain, 128th out of 144. Further, Eurostat data show that in the past 10 years, nearly 80 percent of Bulgarians with PhDs have gone to live or have remained abroad. This policy issue is discussed in more detail in the human capital chapter, which points out that emigration affects not only the highly skilled, but people of all education levels.

73 There are reports of large salary differences between institutions, as researchers in universities are provided with supplements corresponding to their teaching responsibilities, whereas the researchers in BAS are not, but it has not been possible to obtain the hard data to determine the differences.

74 EU-27 average age of the personnel in science and technology (HRST) is 42.8 years old juxtaposed to 44 years old in Bulgaria (age values are averaged based on the Eurostat data 2011 using a simple mean method without a central polynomial interpolation). HRST personnel data compilation differs from the R&D personnel that is used in Box 4.1. R&D personnel data includes all persons employed directly within R&D, as well as persons supplying direct services (such as managers, administrative staff and clerical staff). HRST personnel data is compiled either on the basis of having successfully completed tertiary education or who are employed in science and technology occupations as professionals or technicians.

75 Eurostat
Box 4.3: A Greying Scientific Community

The age profile of scientists is a reflection of the limited opportunities for young researchers to enter the research system. According to the register of the academic staff at the universities supported by the Ministry of Education, Youth and Science (MEYS) in 2008 there was no professor under 35 and only 12 were between 35-44 years of age. Over 600 professors (out of 1290) are over 65. According to the Higher Attestation Commission (HAC) there are 134 senior scientific associates aged between 35 and 44 years (out of 2700) and the majority of senior scientific associates are between 45 and 54 years of age (990 out of 3138). The total ratio of scientists under 35 years old (defined as "young scientists" mainly for the purpose of program funding) to the scientists of other age groups is about 1:10.”

![Age structure of R&D personnel by gender as of 31.12.2011](image)

*Source: Bulgaria’s National Strategy of Scientific Research to 2020.*

**Commercialization of research results**

4.51. Fostering the transfer, exploitation, and commercialization of research results is critical for Bulgaria’s research system to generate substantial economic impacts (
4.52. Figure 4.18). The policy focus in Bulgaria, as in many ECA countries, has been to promote knowledge transfer via the “supply-push” path to commercialization. Science policy and funding instruments in Bulgaria were designed with the idea that scientists are at the origin of R&D projects, that the main barrier is selling the new idea on the market and the technological sophistication and risks tend to be high to medium. In this context, the priority has been to give scientists the resources to develop their projects until the applications are clear, under the assumption that a private partner can be attracted later on. This is in contrast to the “demand-pull” model, in which the starting point is a market need, the main barrier is identifying that need and the technological sophistication can be medium to low.

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76OECD Science, Technology and Innovation Outlook 2012.
4.53. Currently the absence of technological development limits “demand-pull” mechanisms that incentivize research commercialization. Indigenous technological development came to a near standstill in 1990, reducing the demand for consulting services or research consortia with local researchers. Companies prefer to import modern machinery and equipment rather than invest in long-term technology development. About 90 percent of Bulgaria’s total investment is in machinery, compared to 50 percent in Germany; the share of investment in intramural and extramural R&D in Bulgaria is less than 10 percent, whereas in Germany it is close to 50 percent.77

4.54. The only exception is the ICT industry, where new technologies are increasingly being protected at the EPO or the USPTO. However, because the new generation of patents is a result of the R&D activities of subsidiaries of global ICT leaders such as SAP and VMW (Figure 4.19), there is a large technology gap between foreign entrants and domestic PROs, and this creates problems for collaboration. Bulgaria’s technological specialization, proxied by patent applications in the period 1997-2011, is shown in Figure 4.20.

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4.55. Bulgarian legislation in the area of IPR is in line with the EU framework, which facilitates technology transfer, but there are problems with enforcement and the capacity of the judiciary. While Bulgaria ranks 50 out of 130 countries in terms of IPR protection, it drops to 94th on enforcement. Commercial litigation is generally time-consuming and there are significant costs associated with such court proceedings which can be a serious deterrent for enforcement.

4.56. In addition, the IPR system is detached from other policy initiatives fostering research and innovation. Specifically, the lack of coherent policies to encourage IPR disclosure, patenting, monetization, and royalty distribution impedes research commercialization by PROs.

4.57. IPR guidelines have been introduced in several Bulgarian institutions that clarify who owns and who can manage academic inventions. Both the BAS and Sofia University (Table 4.3) have incorporated some aspects of the US Bayh-Dole Act\textsuperscript{78}, which should make it easier to commercialize the results of research. However, Bulgarian researchers prefer to register patents, utility models or copyrighted materials that have immediate commercial value on their own, rather than protecting IPR with the...

\textsuperscript{78} The 1980 Bayh-Dole Act is seen as the catalyst for the commercialization of research in the US national laboratories, leading many countries to adopt similar rules. The Act gave institutions the unambiguous right to claim title to inventions made with federal funding. For an overview of the Act and its impact, see
Institutions where they work. In cases where a technology transfer office (TTO) has been involved in the process, typically the IP has little commercial value.

Table 4.4: Comparison of the IPR guidelines between BAS and Sofia University

<table>
<thead>
<tr>
<th>General rule of IP ownership</th>
<th>BAS holds all rights on IP, if it was developed:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• using funding provided by or through BAS</td>
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<tr>
<td></td>
<td>• based on knowledge and expertise gained</td>
</tr>
<tr>
<td></td>
<td>though BAS</td>
</tr>
<tr>
<td></td>
<td>• in the course of regular employment</td>
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<tr>
<td></td>
<td>• by graduate students or persons using BAS</td>
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<tr>
<td></td>
<td>IP in their research</td>
</tr>
<tr>
<td></td>
<td>• as a result of special assignment</td>
</tr>
<tr>
<td>Exceptions to the IP ownership rule</td>
<td>BAS ownership of the resulting IPR can be excluded by contractual arrangement.</td>
</tr>
<tr>
<td></td>
<td>• IP is developed for the scientific career</td>
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<tr>
<td></td>
<td>development by BAS researchers without</td>
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<td></td>
<td>any financial or other support from BAS</td>
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<td></td>
<td>(e.g. scientific publications, conference</td>
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<td></td>
<td>presentations, books, study guides).</td>
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<tr>
<td></td>
<td>• IP resulting from research based on</td>
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<td></td>
<td>classified information;</td>
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<tr>
<td></td>
<td>• IP resulting from research commissioned by</td>
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<tr>
<td></td>
<td>government institutions under government</td>
</tr>
<tr>
<td></td>
<td>IP rules.</td>
</tr>
<tr>
<td>Royalty share</td>
<td>All IP resulting in the course of employment or education (graduate students) is sole property of the University.</td>
</tr>
<tr>
<td>BAS</td>
<td>Sofia University</td>
</tr>
<tr>
<td>BAS holds all rights on IP, if it was developed:</td>
<td>BAS ownership of the resulting IPR can be excluded by contractual arrangement.</td>
</tr>
<tr>
<td></td>
<td>• using funding provided by or through BAS</td>
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<td></td>
<td>• based on knowledge and expertise gained though BAS</td>
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<td></td>
<td>• in the course of regular employment</td>
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<td></td>
<td>• by graduate students or persons using BAS IP in their research</td>
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<tr>
<td></td>
<td>• as a result of special assignment</td>
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<tr>
<td></td>
<td>All IPR resulting in the course of employment or education (graduate students) is sole property of the University.</td>
</tr>
<tr>
<td></td>
<td>The IPR guideline offers the University considerable flexibility in applying this rule whereby allowing a royalty split between the University and the researchers, or full assignment of IPR to the researchers, based on contractual arrangement.</td>
</tr>
<tr>
<td></td>
<td>Depending on the contractual arrangement, the researcher team can retain:</td>
</tr>
<tr>
<td></td>
<td>• 100% of the royalties;</td>
</tr>
<tr>
<td></td>
<td>• 90% of the royalties, if the research team hire the University TTO as a consultant to manage the IPR on their behalf. In this case the TTO receives 10% of the royalties;</td>
</tr>
<tr>
<td></td>
<td>• 50% of the royalties, if the research team retains resulting IPR and merely hires the TTO to manage it. In this case the University retains the other 50%;</td>
</tr>
<tr>
<td></td>
<td>• 33% of the royalties, if the researcher team assigns resulting IPR to the University and the TTO manages the IPR on behalf of the University. In this case the royalties are split equally between the University, the TTO and the research team.</td>
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</table>


4.58. Integrating IPR issues into research and teaching is another area where Bulgaria is currently lagging behind the EU. There are few resources available to researchers, entrepreneurs, and SMEs to help

Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme ”Development of the Competitiveness of the Bulgarian Economy” 2007-2013”, financed under Priority Axis 5 “Technical Assistance” of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
them take advantage of the IPR system. The anticipated IPR outputs from research projects are not sufficiently prioritized in the evaluation of projects competing for NSF research funding. With regard to the education system, teaching IPR from a business perspective is not yet a standard feature of university curricula in science, engineering, technology, or management. Few education institutions offer IPR training programs for inventors, researchers, entrepreneurs, or managers of SMEs.

4.59. Several technology transfer offices (TTO) have been established to incentivize commercialization of research, but the results to date are limited. The TTOs were created or supported with EU funding from PHARE and the OPC, and most are based in higher education establishments and BAS institutes. Although the TTOs created a certain degree of awareness about the importance of technology transfer and research commercialization inside PROs, the current TTO infrastructure is ineffective for the reasons explained below. The establishment of a TTO consortium under the OP IC program that will be outlined in the recommendations section could begin to address the deficiencies in the system.

- The existing TTOs do not have adequate in-house capacity to successfully carry out critical commercialization functions. This is due to a lack of well-trained and highly specialized staff needed to execute the technology commercialization processes.
- Most TTOs depend on public support for more than half of their operating budget, and only a smaller share of their income is from commercialization activities and private sources (see Table 4.5. The volume of “commercializable” research is low in most PROs, and therefore TTOs are unable to justify expenditure in high-end resources (such as market research databases and patent analytical tools) required for technology commercialization.
- Currently each PRO follows a different policy regarding patenting and royalty sharing. Lack of uniform and consistent overarching policies regarding disclosures and IP management has hindered promotion of best practices in handling of IP and commercialization in institutes.
- There is no common standard or policy to handle routine procedures in commercialization such as Material Transfer Agreements (MTAs) and Inter-institutional agreements (IIAs). Uniform policies for Inter-institutional agreements related to IP management and royalty sharing in cases of joint research ventures would help to promote greater collaboration among institutes.

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79 Nine technology transfer offices were supported financially in the period up to 2007 under PHARE, as one of the measures to implement the Innovation Strategy of the Republic of Bulgaria; and with accession to the EU, the Operational Program Competitiveness has given support to already established offices. The technology transfer offices were established in the following institutions: Sofia University; Ruse University; Naval Academy, Varna; Technical University, Gabrovo; Prof. Dr. Asen Zlatarov University, Burgas; Agricultural University, Plovdiv; Maritsa Vegetable Crops Research Institute, Plovdiv; Institute of General and Inorganic Chemistry, BAS; Space Research and Technology Institute, BAS.
Services such as material testing are currently done abroad for the most part. Maintaining record of national demand for such services could help decide the feasibility of developing national capabilities in the needed field thus answering the build-versus-outsource question.

Lack of commercialization success stories has not created a culture of commercialization. Salient examples of commercialization successes can help to break this vicious cycle.

Linkages between researchers and industry are weak. Building strong linkages between industry and research community would help to create a culture of mission oriented research and technology commercialization.

IP marketplace is non-existent. High transaction costs in commercialization due to a distributed system and lack of practices such as bundling of patents from different institutes has been detrimental.

Table 4.5: TTOs funding sources

<table>
<thead>
<tr>
<th>Source of funding</th>
<th>GIS BAS</th>
<th>JIC BAS</th>
<th>IGIC-BAS</th>
<th>TTO-SU</th>
<th>JGC</th>
<th>TTO-PU</th>
<th>Univ of Forestry</th>
<th>ARC Fund</th>
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<tbody>
<tr>
<td>Own sources</td>
<td>40</td>
<td>30.58</td>
<td>10</td>
<td>25</td>
<td>7</td>
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<tr>
<td>Funds from parent organization</td>
<td>60</td>
<td>8.36</td>
<td>80</td>
<td>30</td>
<td>13</td>
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<td>Governmental agencies</td>
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<tr>
<td>Foundations/international organizations</td>
<td>55</td>
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<td></td>
<td>10</td>
<td>100</td>
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<tr>
<td>Firms</td>
<td>15</td>
<td>4.19</td>
<td>5</td>
<td>65</td>
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<td>Income from commercialization/</td>
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<tr>
<td>knowledge transfer activities</td>
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<tr>
<td>Others, please indicate:</td>
<td>25</td>
<td>12.78</td>
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E. Recommendations

4.60. Reversing the decline in scientific productivity and increasing the economic and social impact of public funding for science is a major challenge that impedes Bulgaria’s growth toward the knowledge economy. The Smart Specialization Strategy provides a unique opportunity to discuss and agree on the funding and institutional reforms that need to be set in motion so that Bulgaria can achieve its goal of becoming a competitive EU partner and a moderate innovator by 2020. These actions will need to be embraced by system stakeholders and aligned with commitments at the heart of the National Strategy of Scientific Research to 2020 (Box 4.4).\(^\text{80}\)

Box 4.4. Directions set out by Bulgaria’s National Strategy of Scientific Research to 2020

In 2011, the Government of Bulgaria adopted the National Strategy of Scientific Research to 2020 (NSSR hereafter) that highlights the following objectives to advance research in Bulgaria:

1. Construction of competitive national research infrastructure as a part of the European Research Area.
2. Improvement of the service and control of the research infrastructure in Bulgaria.
3. Strengthening the integration between the scientific institutes, units of the public scientific organizations, universities and business in compliance with public priorities.
4. Raising the scientists’ status in society.

The above objectives are intended to be achieved through the following tasks and measures:

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Measures</th>
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</thead>
</table>
| Task 1: Increasing the intensity, effectiveness and efficiency of R&D activity | • Measure 1: Introduction of financing model stimulating competition for socio-economic, and increase of the funds for research and innovation.  
• Measure 2: Establishing scientific research priorities  
• Measure 3: Strengthening Research potential development through creation of attractive conditions for scientific career, professional growth, qualification and specialization of scientists |
| Task 2: Establishment of a sustainable education-science-business relation as a basis for development of knowledge-based economy | • Measure 1: Stimulation of private sector involvement in scientific activity  
• Measure 2: Strengthening the integration between the knowledge triangle elements |
| Task 3: Creation of favorable environment for scientific activity     | • Measure 1: Introduction of scientific activity evaluation  
• Measure 2: Development of research infrastructure  
• Measure 3: Strengthening the social dimensions of science |

Five scientific priority areas that are expected to have high economic and social impacts are proposed. These areas were identified based on Bulgaria’s European Development Program, an analysis of the scientific activity, as well as economic and export potential analysis performed with the support of the World Bank, and aligned with priority areas identified in FP7 framework and outcomes of “Creating an Innovative Europe”[1] report. These areas should receive 70 percent of the national R&D financing in future. The areas are:

1. Energy, energy efficiency, and transport; development of green and eco-technologies;  
2. Biotechnologies and ecological foods;  
3. New materials;  
4. Cultural and historical heritage;  
5. Development of fundamental research under competitive principle (15% of science public expenses)  

Information and communication technologies (ICT) will be developed as a cross-cutting area.

The NSSR includes monitoring indicators to assess the progress of specific tasks. These include, for example: the percentage of public resources for science used in priority areas; the number of institutions participating in the European Roadmap for Research Infrastructure; the number of national research networks established. See NSSR for details of the M&E framework.

Source: NSSR.  

4.61. This section provides recommendations in the areas covered by the diagnosis—organization of research, public funding for research, the implementation of support instruments, academic careers, and commercialization of research.
Recommendation 1: Promote the restructuring of the research system by undertaking a system-wide evaluation, agreeing on a reform roadmap and channeling resources to upgrade, merge, or close PROs

4.62. As discussed in the diagnosis, Bulgaria’s research system needs to be restructured to tackle the following problems: (a) a bias toward basic research, with limited mission-oriented and applied research that could have a much higher economic and social impact; (b) weak synergies between research and teaching, a legacy issue that undermines the quality of both activities; and (c) virtual absence of high-quality research outside Sofia, which inhibits other regions from developing knowledge-based economic activities.

4.63. Changes in the governance of the research and innovation system and institutional reforms at the level of PROs are two necessary ingredients to improve the performance of the research system. Chapter 2 provides detailed recommendations on how to enhance coordination across line ministries and strengthen long-term policymaking capacity. Identifying and agreeing on institutional reforms in individual PROs will take time, because there is no consensus about the approach or next steps. In the past, there have been frequent calls to merge BAS institutes with universities to generate synergies between research and teaching and to close underperforming institutes and universities that absorb fiscal resources. The academic community is not behind either of these options due to perceived risks that this will erode research capacity and lead to further reductions in the number of research positions.

4.64. The first step of the restructuring process should be to commission a system-wide independent evaluation that will assess and rank all PROs. An independent evaluation by international experts would give policymakers and stakeholders a clear and comparable picture of the situation in each PRO and would help to identify evidence-based actions, which could range from targeted support to merger or closure. The ESF-ALLEA independent evaluation of BAS carried out in 2009 provides an adequate framework for evaluating the scientific quality in individual PROs, but this would need to be complemented by an in-depth assessment of organizational aspects, recruitment and promotion policies, capacity to commercialize research and engage in public-private cooperation. Annex 4.3 provides a comparison of the evaluation in BAS and international good practices from UK, France and Netherlands. These need to be tailored to the Bulgarian context.

4.65. The second step should be to commission a high-level task force to agree on the long-term vision for the research system and a reform roadmap that will strengthen the areas identified by the independent evaluation. The task force would need to be chaired by the Minister of Education and Science and include representatives from the management of the PROs and top researchers. The task force would be charged with developing a restructuring plan for BAS and the universities that would more equitably distribute research funds and human resources throughout the system (Box 4.5)
A recent World Bank report[1] provides the following recommendations about the restructuring of the PROs:

- Restructuring cannot be a one-size-fits-all approach; it requires a careful assessment of (a) the scientific contributions of the PRO in question, and specifically whether it produces substantial public goods (i.e., research that is internationally recognized); as well as (b) the market relevance of the research. Figure shows the possible scenarios and the restructuring options.

- An institute/faculty that is doing well in basic research yet has limited market relevance could either: (a) establish a plan to enhance its results orientation and efforts toward commercialization; or if commercialization is not feasible (e.g., in theoretical physics), (b) establish a plan to merge with similar institutions to consolidate national research capacity and advanced human capital. In the case of larger BAS institutes, one option to strengthen the management would be through a BAS-owned contractor-operator arrangement that brings a strategic partner such as a Fraunhofer Institute.

- An institute/faculty with sufficient market potential (able to cover 50 percent or more of its expenses through a mix of competitive and contract funding) could be given independence in terms of management, hiring and investment policies, and IPR and technology transfer activities.

- An institute/faculty with limited research capacity and limited market demand would need to implement a corrective plan with defined milestones or merge with a teaching university, which could then inject research capacity into the system.

**Figure: RDI reform decision tree**


4.66. The third step would be to earmark budgetary resources to implement the restructuring of PROs, taking care to mitigate the risks that have been observed in other ECA countries. The restructuring effort will be costly in the short term. Every option is likely to require extra resources to hire professional management and young researchers, make targeted investments in facilities and equipment, and in the case of merger/closure, to cover the costs associated with early retirement of personnel and transfer of facilities.

4.67. For the restructuring process to work, it’s essential that all PROs participate in the evaluation and in the design and implementation of the restructuring plan. The top institutes and universities are likely to support this process, as this would give more autonomy and resources, but there is a need to create incentives so that all PROs participate. Earmarking resources for the restructuring will help, but in addition, PROs that opt out from the evaluation should not be eligible to get grants from the NSF or EU funds from the OPs.
4.68. The outcome of this restructuring process would be a leaner and more effective research system. The PROs would become more oriented to technological development and diffusion, which will attract more income from private sources. At the same time, the BAS institutes that are merged into universities would provide the critical mass for the creation of centers of excellence where support for research and innovation can be concentrated to produce results that are visible at the European and global level.

**Recommendation 2: Improve the efficiency of public expenditures on scientific research by tying research funding to measurable improvements, matching external funds, and shifting from institutional to competitive funding**

4.69. The Government of Bulgaria, as part of its commitments under the Europe 2020 Strategy, has adopted a national R&D investment target of 1.5 percent of GDP by 2020. This implies an increase in public R&D of 0.5 percent of GDP in real terms over the Smart Specialization Strategy (S3) period if the ratio of public-to-private R&D spending remains at today’s level of 50 percent. Part of this increase could come from improved absorption of EU funds, but the rest would need to come from a boost in national budgetary funds.

4.70. Allocating more funding to research could have a major economic and development impact, provided the right funding mechanisms are used. Current levels of research funding are insufficient and excessively reliant on institutional base funding going to BAS and universities. Introducing one or more of the mechanisms outlined below would greatly improve the efficiency of public expenditures earmarked to scientific research, creating powerful incentives excellence and collaboration:

- Tying future increases in funding to measurable improvements in the performance of PROs, would create incentives to reallocate resources towards the most prolific research teams. On the basis of the foregoing diagnosis, it is recommended that future increases in institutional funding be made conditional on the PRO performance. The funding provided through the UK Research Councils is a good example of how to tie funding to regular independent assessments. The assessment is carried out every five years, and research funds are distributed to university departments and laboratories based on the results.

- Giving additional funds to PROs that are able to secure external resources would incentivize collaboration with private sector, facilitate participation in consortia and gradually diversify the funding base\(^81\). MES could put this into practice by setting aside a

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\(^81\)International experience shows that PROs that are oriented to technological development can have a diversified funding base that provides the right mix of capabilities and incentives. The target should be to achieve a balance between block grant funding, matching and competitive funding and private payments: (1) One third of baseline funding for capacity building and maintenance, (2) a program of R&D funded by the State and enterprises, or broad-
dedicated pot of funding which would be automatically distributed to PROs on a first come-first served basis, matching the external resources that each institution attracts from private sources or EU sources such as the EU Framework Programmes. If the matching were at a 1:1 ratio, the pot of funding would need to roughly equal the volume of external resources obtained in the previous year, but the leverage effect could be greater depending on the available funds. The advantage of this scheme is that funds could be quickly disbursed, red tape and cost of administration would be minimal, the parameters can be adjusted to take account of priority areas, and the resources would help to cover the costs of national co-financing for European projects.

- Scaling up the volume of competitive project funding would ensure better targeting of resources toward the best teams and projects. This is the approach favored by the NSF, but there are continuing problems in terms of instrument design, implementation, and evaluation. As discussed further below, the selection process for the competitive grants should prioritize collaborative projects, mission-oriented research in priority areas, and programmatic R&D. The recent economic downturn led to a sharp reduction in NSF competitive funding, putting in jeopardy the results from past investments in scientific research. A stable level of research funding is needed to nurture the work of research teams.

4.71. The right delivery mechanism is needed to improve the efficiency of public expenditures. In addition to redesigning the NSF instruments, which we discuss in more detail below, the delivery mechanisms for science funding needs to be overhauled to strengthen the implementation capacity. The following weaknesses identified by different assessments (for example, the 2006 independent assessment of the NSF and recent Arc Fund Innovation.bg reports) would need to be addressed:

- **Changing the balance between top-down and bottom-up funding:** The bottom-up funding approach should be maintained, but a considerably larger amount of money should be allocated to top-down, thematic funding in line with European and national priorities.
- **Increasing the duration of programs and projects:** Larger networks or centers of excellence should receive funding for up to five years, whereas the existing smaller projects funded based on researchers’ proposals should continue to receive funding for a maximum of three years.
- **Using periodic calls or open windows:** Funding for individual researchers should be available throughout the year, to provide support when it is most needed. There should be one date for the submission of applications under the thematic and general calls, in line with the academic year.

based dissemination of technology primarily funded by the state and groups of associates, and (3) the final third, technological services and contracts to the private sector and R & D with the private sector.
Profile of evaluators: Each pair of project referees should include an international evaluator to evaluate written proposals. For projects involving a large network of researchers or future centers of excellence, the evaluation should be carried out exclusively by international reviewers.

Simplifying the project selection procedure: Funding proposals should move to electronic submission, and all proposals and reviewer reports should be in English. Panels of experts should meet only once for each call, to rank and fund the proposals. Each member of the panel should receive a set fee for his or her two-year period of service.

Strengthening the monitoring and evaluation: The intermediate evaluation at the end of the first year should constitute only a financial audit of the project, and can be carried out by an administrator. No scientific results can be expected after only one year. At the end of the second year, both the financial and scientific aspects of the project should be evaluated.

Recommendation 3: Redesign the scientific support instruments to stimulate collaborative and mission oriented research and strengthen the research infrastructure

4.72. The NSF funding instruments need to be redesigned to better target high-impact research, particularly research that is collaborative and mission oriented. Experience in emerging countries indicates that collaborative research can increase scientific productivity and is the key to finding multidisciplinary solutions to scientific challenges. The Innovation Advisory Council together with other stakeholders should play a role in identifying those scientific areas that can directly contribute to the development of the national economy. The experience of leading EU research institutions offer useful lessons about how to reinforce Bulgaria’s mission-oriented research (Box 4.6).
Box 4.6. EU mission-oriented research institutions and Lessons for Bulgaria’s context

I) Food sector: The National Institute for Agronomic Research (INRA) in France[1] is a national mission-oriented institute ranked a number one agricultural institute in Europe. INRA carries out mission-oriented research for high-quality and healthy foods, competitive and sustainable agriculture. INRA was established in 1946 under the joint supervision of the Ministry of Agriculture and Fisheries and the Ministry of Higher Education and Research. In 1984 INRA gained a status of mission-oriented research institute, in 2000 it expanded from the single base of “agriculture and related industries” to the triple field of agriculture, diet and food, and environment, and in 2005 INRA embraced more global issues around sustainability. Take away (i) successful example of how government support transformed an existing research institution into a mission-driven research leader in Europe; (ii) INRA’s business model and research agenda are updated regularly to take into account the transforming world economy and natural environment.

II) Mechatronics and Automotive sector: The Fraunhofer High-Speed Dynamics Ernst-Mach-Institute (EMI) and Fraunhofer Institute for Structural Durability and System Reliability (LBF) in Germany[2] are a tandem partners for complex questions of reliability and safety in the automotive sector. The LBF builds its expertise on more than 65 years of experience in the field of structural durability, and recently expanded to the complex mechatronic/adaptronic systems. The EMI, analyses the physics of high-speed, transient processes in order to develop new approaches and cutting-edge solutions for applications in the business segments defense, security, space and transport. With overall competences in these fields, both LBF and EMI develop, evaluate and implement comprehensive solutions for safety relevant products in the automotive area, thereby addressing the full added value chain from the first idea to the product, from material to system throughout the entire life cycle. Take away: (i) an institutional capacity to both anticipate and ‘catch up’ with industry needs, identifying the most productive areas and promoting high-growth firms; (ii) effectiveness in attracting the research revenue derived from contracts with industry and from publicly financed research projects.

III) Health and Biomedical sector: National Institute of Health and Medical Research (INSERM)[3] is one of the key public research institutes in France that is involved in the mission-oriented research implementing the main strategies of health and medical research in scientific priorities and R&D programs. Established in 1964, INSERM is a public institution with a scientific and technical vocation under the joint authority of the Ministry of Health, Youth and Sport and Ministry of Higher Education and Research. Its principal mission is to facilitate exchange between basic research, clinical research, therapeutic or diagnostic research and public health across the fields of biology, medicine and public health. Of INSERM’s 316 research laboratories, 80 per cent are housed in university hospitals or CLCC, with the others located on CNRS research campuses the Pasteur Institute and Curie Institute (Institut Curie). INSERM performs the largest share of public biomedical R&D among all mission-orientated institutions. Take away: mission-led organizations can’t successfully work in silos, and in order to fulfill the mission, the institutions extensively work in partnership with other private and public research institutions.

IV) ICT sector: Italian National Agency for New Technologies (ENEA)[4] ICT Research Center is focused on: high-performance and distributed computing; very-high-performance data transmission networks; integration of heterogeneous systems such as scientific facilities and laboratories, ENEA manages and develops High-Performance Computing (HPC) facilities for a total of more than 3,500 processors, with a data storage space of over 150 TB. Portici Research Centre hosts the CRESCO supercomputer, the Agency’s leading computational infrastructure, a first class facility at the national level. Currently, the ENEA HPC infrastructures are used by a significant number of laboratories and research groups in the fields of climate modeling, complex technology network simulation, bioinformatics, energy, new materials. Take away: (i) advanced computing capabilities are needed for interdisciplinary and multidisciplinary research working groups because of the cross-cutting nature of ICT; (ii) “virtual laboratories” are needed for ‘real-time’ collaboration between national and international research bodies and companies.


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4.73. Fostering collaborative research requires new instruments. There are different types of collaborative research that have different goals, including mission-oriented research, multidisciplinary research, and research co-financed with the private sector. New instruments are needed to channel substantial volumes of programmatic funding that aim to: (a) in the short term, build the capacity of existing research teams and facilitate the creation of public-private research consortia; and (b) in the long term, lead to the creation of centers of excellence and large-scale research infrastructure that has a strong position in European research.

- **Introducing a collaborative research financial instrument** could have a significant demand-pull effect on the research orientation of PROs. Collaborative research grants in the range of €400,000 to €1.5 million could be given to high potential research groups based on strong excellence criteria plus mission-oriented and/or multidisciplinary criteria. These programs could last three to five years. To promote a culture of collaborative projects, several countries are providing funding in this range to projects in which the PRO can attract at least 20 percent of effective co-financing from private companies or other public institutions that are interested in the result of the projects.

- **A research networks instrument** could help to establish consortia programs involving research groups, local businesses, and international research centers and companies. Countries that have successfully developed these types of initiatives include Australia, Finland, Israel, and most recently, Chile. Australia has gone further, establishing industry-university Cooperative Research Centres (CRC) that have had good results in terms of reorienting the areas of research of important groups of researchers.

- **A center of excellence instrument** could facilitate the creation and upgrading of mission-oriented research PROs with recognized international visibility. PROs that have a track record of collaborating in multidisciplinary or mission-oriented research could participate in obtaining base financing and program financing to support their collaborative efforts, including collaboration with international centers. In the case of Bulgaria, it is strongly recommended that the mission-oriented centers of excellence be associated with human capital development at the undergraduate and graduate levels. Universities and BAS institutes could establish joint programs in which research scientists would have a joint appointment at a university and would undertake teaching responsibilities and thesis supervision in addition to research.

4.74. Centers of excellence had been established under past Framework Programmes. The creation of the centers increased the visibility of Bulgaria’s research and gave a boost to the host institutions, which took advantage of the ‘spike’ in research funds to retain young researchers, foster international mobility and renew scientific equipment. Generally, the effect on the volume and quality of publications and other outputs turned out to be short-lived, as the research activities could not be sustained without these grants. In the future the funding for centers of excellence would need to be on a larger scale and for longer periods of time to have a lasting impact on the performance of the PROs and to consolidate research.

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capacity. The centers could also be a way to introduce changes in the management structures and incentives.

4.75. The Israeli Centers for Research Excellence (I-CORE), which is part of the Higher Education multi-year Reform Plan, is a good example of a program that is providing resources to establish leading research centers specializing in disciplines where the government wants to intensify its mission-oriented research. The current wave of the program will give US$200 million to 16 centers over a five year period, and it will pave the way for the establishment of inter-institutional Joint Graduate Schools to encourage collaboration between institutions of higher education.

4.76. It’s also important to introduce new models for the acquisition and sharing of large-scale research infrastructure in order to update scientific equipment in a strategic way, improve access among interested users and make possible a more balanced sharing of the costs. International experience shows that equipment tends to remain underutilized when it is purchased and used by a single research project or center. The OECD’s guidelines about funding for large-scale research infrastructure underlines the need to bring potential partners together early on to define the scientific nature of the project, the characteristics of the project site, and agree on cost estimates and budget sharing. More details are discussed in Box 4.7.

**Box 4.7: OECD recommendations for financing international large-scale research infrastructure**

According to the OECD Global Science Forum (GSF), the agreement process among contributing partners (governments, agencies, research institutions) needs to overcome the following hurdles:

1. *To agree on the total cost of the infrastructure among contributing Partners*
2. *To agree on how contributions will be provided: in cash or in-kind (or a calculated mixture) and how cash will be spent (e.g. contracting rules).*
3. *To arrive at an agreed scale (formula) of contributions from the Partners:* Large international research projects have been funded using a variety of schemes, among them equal shares, shares that are computed according to an algebraic formula, using Gross Domestic Product (GDP) and other input variable, and shares linked to access to the resources of the infrastructure.


4.77. Countries like New Zealand have experienced for many years with Share Scientific Service Units that provide the scientists the possibility of sharing expensive equipment and paying for maintenance, variable costs and some overhead. Key to the success has been to organize this unit’s structure as service centers with a pressure to generate revenues through good quality services. The personnel of these units are mostly technicians that know how to use the equipment. An example of two models for accessing the large-scale infrastructure is exhibited in Box 4.8.

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82Bulgaria’s National Roadmap for Research Infrastructure was approved in September 2010. This roadmap describes the participation of Bulgarian institutions in the consortia implementing the European Roadmap for
Box 4.8: Sharing and Access Rules to Large-Scale Research Infrastructure

According to interviews of world experts by OECD, many research facilities continue to follow the 1980’s guidelines by the International Committee for Future Accelerators (ICFA) to share large research infrastructures. Under these guidelines, international access to a facility was based solely on the merits of the proposed research taking into account the capabilities of the researchers, the importance of the proposed measurements, chances of a successful outcome, and operating costs.

The international research community is currently debating whether ICFA guidelines (or other “open, merit-based” principles) can continue to be used, alluding to the advantages and drawbacks in the table below. An alternative model would be to grant access to researchers based on the fractional financial contribution of their country or institution. A variety of attributes could be used to assign a national designation to research proposals: the nationality of the investigators, of the main home institution, etc.

<table>
<thead>
<tr>
<th>Advantages of ICFA guidelines</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Maximizing the scientific output, advancing the frontiers of universally accessible knowledge.</td>
<td>• Cutting-edge research is increasingly concentrating around a small number of international infrastructures that are very costly to build and operate.</td>
</tr>
<tr>
<td>• Reinforcing solidarity within the research community, and rewarding excellence regardless of impeding (e.g., economic imbalances, geopolitical strife).</td>
<td>• The scientific resources provided by the facility are heavily oversubscribed by potential users.</td>
</tr>
<tr>
<td>• Promoting balance and reciprocity in a global system where all scientists could compete equally for use of the best facilities anywhere in the world.</td>
<td>• Partners are motivated to maximize their use of the infrastructure and have to provide an accounting to national authorities based on cost-effectiveness or competitive advantage.</td>
</tr>
<tr>
<td>• Simplifying facility operations by not having to keep track of, and manage, utilization quotas.</td>
<td>• Access restrictions apportioned among partners using an agreed formula and procedures in order to discourage “free riding” when a national entity decides not to become a paying partner, trusting that its scientists will obtain access based on the excellence of their future research proposals.</td>
</tr>
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**Recommendation 4: Establish a merit-based national funding program to retain and attract top scientists and young researchers with clear potential based on regular independent evaluations**

4.78. Many countries have developed a national system of research grants and stipends to individual scientists to mitigate the brain drain, stimulate scientific productivity, and strengthen incentives to pursue Research Infrastructure as well as seven projects to reinforce Bulgaria’s research infrastructure in areas from genomics to supercomputing. Research Infrastructure means research equipment, facilities, databases, large-scale computer networks, specialized research laboratories, unique geography and natural resources and services that the scientific community needs in order to perform modern, high-quality and compatible scientific research, transfer, exchange and scientific knowledge protection.

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academic careers. Normally there are small grants for young researchers or postdocs to enter academic positions with some research funding. Larger grants typically provide financing for two or three years, and include resources for the main researcher, research assistants, and laboratory materials.\textsuperscript{83}

4.79. Establishing a merit-based fellowship program for top scientists and young researchers with clear potential would be much more efficient than a blanket increase in salaries. For this to create the right incentives, the stipend would need to be large enough to bring researchers’ salaries in line with those available in relevant EU countries. The fellowship program could start as a pilot with a limited number of positions, and grow over time.

4.80. To receive academic grants, Bulgarian researchers should be required to participate in regular independent evaluations to assess their scientific achievements and the quality of their proposals. This program would involve a competitive process based on criteria of academic excellence and the quality of the proposals. Performance should consider not only scientific outputs, but also collaboration with private sector, patenting, licensing, etc. Regular independent evaluations will be important to ensure that the process is credible and transparent. Once the academic grant program is established, it will be possible to open special calls for recent PhDs to facilitate the retention of young researchers. The NSF has provided some funding to young researchers through specific calls for proposals, but it has not established a comprehensive system of academic research grants and the amounts are too small.

4.81. The National System of Researchers in Mexico is a pertinent example. It was established in the midst of the economic crisis of the 1980s, as a way to retain top researchers who saw a steep decline in the international competitiveness of their salaries, and to contain the brain drain to the US. Only 1,200 researchers received a fellowship in 1984. By 2012, the number had grown to 18,500, with an annual budget of US$250 million. Young researchers, who recently completed their graduate studies and are starting an academic career, account for 20% of the total number of fellowships. More than 90% of researchers in the system have completed a PhD, compared to 50% in the largest public university, and less than 30% on average in the state universities outside of Mexico City.

4.82. Croatia’s Unity for Knowledge Fund (UKF) is a good example of how to support scientific and professional potential in Croatia and diaspora. The main UKF programs are described in Box 4.9.

Box 4.9: Croatia’s Unity for Knowledge Fund – from ‘brain drain’ to ‘brain circulation’

1. Research Cooperability Program (est. 2008) supports medium-scale collaborative research projects in Croatia with involvement of scientific and research Croatian Diaspora, attracting best research projects to Croatian companies and institutions together with international/private financing, knowledge, technologies and potential

\textsuperscript{83} For example, each project would provide between €20,000 and €40,000 per year with a minimum of €10,000 as additional salary for the researcher. The resources are given to the researcher and the maximum overhead is usually capped at a low level, in the 8-15% range.
Research results.

- **Instruments:** research project, early-stage research, post-doc, short-term visit, long-term visits, consulting, conference, equipment, human resources in S&T and overhead.
- **Grant size:** min 100,000 EUR, max 200,000 EUR

2. **Young Researcher and Professionals Program** supports early-stage researchers and professionals from Croatia in all aspects of their professional advancement, especially by performing projects in cooperation with prominent Croatian and international research and scientific institutions and industry, and by allowing them to autonomously lead research projects.

- **Instruments:** research project, post-doc, early-stage research, short-term visit, conferences, consulting, equipment, human resources in S&T and overhead. Within a proposal, it may be applied for one or more instruments.
- **Grant Size:** max 50,000 EUR


**Recommendation 5:** Develop and implement a comprehensive set of policies that fosters IP disclosure, IP monetization, and university-industry collaboration to commercialize research

4.83. As discussed in the diagnosis section, research commercialization depends on three main elements: (a) strong and deep relations between the research community and industry; (b) a research and innovation conducive IPR regime; and (c) appropriate incentives for commercialization of innovation. Existing support programs do not emphasize these key elements, which makes it difficult for Bulgaria to effectively capitalize on its research capabilities. Insights from international experience indicates that commercialization programs have been successful through the creation of an enabling policy environment and creation of appropriate incentives in the knowledge generation sector, along with establishment of commercialization bodies (such as TTOs) that implement the innovation commercialization agenda.

**Reinforce the IPR protection ecosystem**

4.84. Clear and harmonized guidelines on IPR ownership and royalty sharing at research institutions would provide a necessary protection to the inventor, the PROs and the companies that are involved in collaborative research. Currently there is no uniform IPR policy in Bulgaria. The example in the diagnosis section compared the different set of IP guidelines at the BAS and Sofia University. The World Intellectual Property Organization (WIPO) has issued guidelines for universities and R&D organizations that can facilitate the process of unification of the IPR guidelines at the national level in Bulgaria.

**Box 4.10:** WIPO Guidelines on Developing IPR Policy for Universities and R&D Organizations

**Principles of IPR income sharing**

The WIPO guidelines suggest that the scheme of royalties should encapsulate the following:

(i) universities price externally funded work in a way that recognizes the value of the work in the market;
(ii) universities seek a price for commissioned research that ensures full recovery of costs and also takes into account opportunity costs where rights are assigned or constraints imposed. In cases where a university or R&D institution decides to share part of the project cost, taking account of the relative benefits to the institution and to the sponsor, the details of such a sharing arrangement should be agreed to by all concerned.
Treatment of licenses for non-commercial research and teaching within a university or R&D institution

Many staff and students experience high costs and practical inconvenience in obtaining permission to use material covered by intellectual property protection for research and teaching. Inventors are therefore encouraged to approach publishers and other persons to whom inventors assign rights in their intellectual property and request a non-exclusive, royalty-free license for their own non-commercial research and teaching, including where possible the right of anyone within the R&D institution to use that intellectual property for non-commercial research and teaching.

Treatment of Assignment or Licensing of Relevant Intellectual Property by the Inventor

Universities or R&D institutions may, at their sole discretion, permit the creator or creators to assign or license intellectual property. The institution may not unreasonably withhold its consent to assignment or licensing, and may not withhold it at all unless intending to seek protection itself. Such assignments or licenses are subject to the following provisions, unless the institution waves them in writing:

(i) normally an institution would wish to retain for itself a royalty-free license to use the intellectual property for non-commercial research and teaching on its premises;
(ii) institutions receive a share of all proceeds generated by commercialization of the intellectual property after the inventor has recovered documented out-of-pocket costs for obtaining legal protection. The institution's share is negotiated on a case by case basis.

Source: WIPO Guidelines on Developing Intellectual Property Policy for Universities and R&D Organizations

4.85. In addition, commercialization of research could be catalyzed by IPR policies that:

- Establish a balance between the supply-push approach to commercialization (IP protection, licensing) and the demand-pull variety (contract research). Since licensing of early-stage research is the predominant route to commercialization in Bulgaria, more funding needs to be given to mission-oriented and applied research.
- Enhance incentives to disclose and patent inventions, as full disclosure allows the academic community to continue to build on new knowledge.
- Promote the use of practical tools to value and manage IPR assets, in order to facilitate the development of a market for IP rights. This also calls for the development of mechanisms for the resolution of IPR disputes that are cost effective.
- Encourage the use of IPR as collateral for financing activities, to spur entrepreneurship and help inventors procure early stage financing for their start-ups.

4.86. While measures to improve the IPR ecosystem will take time to implement, raising awareness on benefits of using IPR system is a relatively quick and simple way to boost usage of IPR system and should be conducted in the near term. Educating private sector managers, researchers and entrepreneurs on the role of IP and IP management can lead to greater use of the IPR system. The desirability of different forms of IP pools /auctions/ exchanges should be explored over the medium and long term as the capacity of Bulgarian innovators increases. Such pools can reduce transaction costs between generators and users of IP. These novel mechanisms should be thoroughly studied so that the design responds to local needs.

Strengthen commercialization of research and technology through Technology Transfer Offices

Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013”, financed under Priority Axis 5 "Technical Assistance" of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
4.87. Most research institutions and universities have TTOs, but the TTO system as a whole is ineffective. The key to a successful Bulgarian commercialization model is to adopt an approach which addresses the needs of the Bulgarian innovation ecosystem and not an off-the-shelf approach. Internationally, the model in which every research institution and university has its own in-house TTO has been questioned, because the model has only proven financially sustainable in large academic institutions that are specialized in engineering and sciences, such as Stanford University and MIT.

4.88. Developing a “hub and spoke” commercialization system in which a new TTO hub is established which can provide support to existing TTOs would leverage the strengths of the existing network. The central TTO would serve as a single window for international and domestic licensing and commercialization of all inventions by members of the consortium. The central TTO would also serve as a repository for essential data on commercialization and IP indices and metrics in Bulgaria thus ensuring more regular monitoring and evaluation, and could provide proof-of-concept funding for deserving inventions. The establishment of this central TTO would be a flagship project that would signal Bulgaria’s commitment to deepening relations between research institutions and industry, and could be housed in the new innovation hub in Sofia Tech Park.

4.89. The key to implementing the proposed hub and spoke model for TTOs is to establish a central hub with a core team of experts in IPR marketing, IPR landscape analysis, contract negotiations, and patent issues. Such a centralized TTO would be more than an out-licensing or out-commercialization entity; it could also enhance linkages with global innovation chains by in-licensing patents to foster local research, and respond to commercialization challenges posed by changes in international IP regimes. The local TTOs, for their part, could be responsible for educating the research community about commercialization, triaging the inventions, and ensuring compliance with institutional policies.

4.90. The hub could be established with funds from the OPIC or the OP SISG. Dealing with a single entity (the hub) instead of multiple TTOs with limited administrative and financial capacity would reduce the administrative burden for stakeholders and clients. A central TTO would benefit from economies of scale, enabling the hiring of top experts who tend to command high salaries and purchasing licenses for sophisticated databases used for market and IP research that are out of reach of individual TTOs. Additional training of the TTO staff by experts in the central hub would improve the performance of the TTO consortium. This training would need to focus on business aspects of commercialization; i.e., the need to establish deep connections with industry, conduct patent analysis, search for licensees, perform market research, and guide scientists toward commercially relevant research through the IP landscape and industry analysis.

4.91. Such a system would increase coordination of the activities of TTOs, facilitate the development of harmonized policies, and help to transfer best practices from international experiences to the Bulgarian TTO network. The establishment of a central TTO would address the capacity and sustainability problems with the current system. More effective TTOs would also play a strong part in strengthening the university-industry collaboration. The expected results would be an increase in the number of patents granted to Bulgarians by the USPO and the EPO; faster transfer of research to the market; and an
academic community with deeper insights into market needs and the existing IP landscape, thereby helping inventors to target their research more effectively. An improved IPR and research commercialization environment would complement other innovation support instruments that could be developed under OPIC, such as proof-of-concept labs, seed and acceleration funds, and venture capital.

**Recommendation 6: Using the Operational Program "Science and Education for Smart Growth 2014-2020" to initiate the changes in Bulgaria’s science and research base**

4.92. This section provides suggestions on building effective synergies between Bulgaria’s new OP “Science and Education for Smart Growth 2014-2020” (henceforth OP SESG) and the Smart Specialization Strategy in respect to funding science and research. The concept note of the OP SESG was adopted by the Council of Ministers Decision № 19 of 09.01.2013, assigning an implementation responsibility to the Ministry of Education and Science (MES).

4.93. The research- and science-oriented recommendations in the OP SESG are generally in line with the recommendations provided within the framework of this report, however there’s an opportunity for Bulgaria to scale-up the resources going towards attracting and retaining scientists, as well as strengthening collaboration within the OP SESG 2014-2020.

4.94. For the purpose of this section, only the research-oriented activities within Priority Axis #1 (Specific Objectives 1-3) and Priority Axis #2 (Investment Priority 1, Specific Objectives 1-2) are included in this review, followed by conclusions and recommendations. The budget for activities under Priority Axis #1 “Research and Technological development” is €568,000,000, and these activities are: (i) by 2022 to create 6-8 centers of competence and 8-10 centers of scientific excellence based on an independent international assessment, (ii) by 2022 to establish and upgrade 22 national and regional research infrastructure facilities (including e-infrastructures and platforms) and networks, and (iii) to support applied research and experimental development in priority sectors (performance indicators are N/A yet). The budget for Priority Axis #2 (Investment Priorities 1 and 2) is €85,200,000, however in this review, we analyze only the following categories of activities from the Investment Priority 1, where performance indicators are not yet available: (i) to support activities in training and capacity building for the Bulgarian scientific talent, and (ii) to improve conditions for both mobility and retaining of the Bulgarian top researchers and scientists.

4.95. The new operational program is an important milestone toward revitalizing the under-funded Bulgarian science system. The OP SESG proposes several changes in the way that funding for science is distributed, all of which are very much aligned with the recommendations made in this chapter:

- **OP SESG competitive selection funding, based on an international evaluation of proposals, is a very positive development.** The priority will be given to applicants who have passed an international independent assessment of the research potential of their project and congruency with the National Strategy for Research and Innovation Strategy priorities. This in line with the recommendations to scale up the volume of competitive project funding toward the best teams and projects.
The new OP was endowed with significant amount of resources that demonstrate a high level of political commitment endorsed by the representatives from academia, industry and civil society, and matched by the volume of planned activities.

Introduction of international evaluations will attract more EU and international funding, establishing a climate where additional external funds can be leveraged.

Regional disparities in research are positively taken into account through development of the research infrastructure under the Priority 1.

If successfully implemented, the creation of excellence centers will foster academic-industrial collaborative and mission-oriented research, and promote scientific excellence in the whole system.

4.96. As the OP SESG is finalized, it would be useful to elaborate the specific activities and matching indicators for measuring the impact.

Additional emphasis could be made on providing career development opportunities for the new generation of scientific leaders studying in domestic and foreign institutions. As discussed above, there are different models that could be adopted to attract and retain researchers with demonstrated scientific potential.

OP SESG should establish more synergies and collaboration with other OPs, especially, the OP Innovation and Competitiveness (OP IC) to improve coordination and adequate funding along the innovation chain, thereby filling the funding gaps that hinder research commercialization.

OP SESG M&E framework should be further elaborated in regards to specific results and pertinent indicators.

Introducing a support mechanism to reward PROs that attract private funds would be highly relevant. The recommendations concerning the funding approaches for national budget resources are relevant in this regard.

It would be useful to focus resources on programs that create additionalities and improve incentives at the individual and institutional level, to foster scientific excellence and commercialization of research throughout the system.
ANNEXES

ANNEX 4.1 Scientific publications

Annex 4.1a: Bulgaria’s published articles in peer-reviewed journals by field, per city (1960-2012)

Source: own calculations, SCOPUS, retrieved Jan 9, 2013


Source: SCImago based on SCOPUS, retrieved Dec 12, 2012.

Annex 4.1c: Distribution of scientific publications for Bulgaria (1991-2011)

Source: own calculations, SCOPUS, retrieved Dec 2012

Annex 4.1d: Structure of R&D expenditure by fields of science (%)

Source: own calculations, NSI, retrieved Dec 2012

Annex 4.1e: Top scientific contributors for Bulgarian publications (1991-2009)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Total</td>
</tr>
<tr>
<td>Germany</td>
<td>1</td>
<td>1694</td>
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<tr>
<td>United States</td>
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<td>1061</td>
</tr>
<tr>
<td>France</td>
<td>3</td>
<td>896</td>
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<tr>
<td>Italy</td>
<td>4</td>
<td>715</td>
</tr>
<tr>
<td>England</td>
<td>7</td>
<td>392</td>
</tr>
<tr>
<td>Spain</td>
<td>6</td>
<td>486</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>5</td>
<td>622</td>
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</tbody>
</table>

Annex 4.1e: Top scientific contributors for Bulgarian publications (1991-2009)
Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013, financed under Priority Axis 5 "Technical Assistance" of the Operational Programme, co-financed by the European Union through the European Regional Development Fund

ANNEX 4.2: University rankings

Annex 4.2a: University ranking classification based on industry and disciplines

<table>
<thead>
<tr>
<th>Industry/Field</th>
<th>Discipline</th>
<th>University/Institution</th>
<th>Teaching</th>
<th>Science and learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food processing</td>
<td>Food technology</td>
<td>University of Food Technology</td>
<td>50.13</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rousse University &quot;Angel Kanchev&quot;</td>
<td>67.88</td>
<td>36.71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trakia University - Stara Zagora</td>
<td>50.3</td>
<td>54.41</td>
</tr>
<tr>
<td>Plant Breeding</td>
<td>Agricultural university</td>
<td>University of Forestry</td>
<td>63.38</td>
<td>66.49</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trakia University - Stara Zagora</td>
<td>50.45</td>
<td>65.35</td>
</tr>
<tr>
<td>Animal Breeding and reproduction</td>
<td>Agricultural university</td>
<td>Trakia University - Stara Zagora</td>
<td>61.1</td>
<td>57.39</td>
</tr>
<tr>
<td>Machinery and Electronics</td>
<td>Electrical, electronics and automation</td>
<td>University of Chemical Technology and Metallurgy</td>
<td>81.41</td>
<td>74.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical University of Sofia</td>
<td>62.66</td>
<td>81.64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rousse University &quot;Angel Kanchev&quot;</td>
<td>63.6</td>
<td>44.3</td>
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<tr>
<td>Mechanical Engineering</td>
<td>Technical University of Sofia</td>
<td>Technical University of Sofia</td>
<td>56.24</td>
<td>85.29</td>
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<tr>
<td></td>
<td></td>
<td>Rousse University &quot;Angel Kanchev&quot;</td>
<td>72.71</td>
<td>47.43</td>
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<td></td>
<td></td>
<td>Technical University of Gabrovo</td>
<td>69.12</td>
<td>50.78</td>
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<tr>
<td>General Engineering</td>
<td>Technical University of Sofia</td>
<td>Technical University of Sofia</td>
<td>71.21</td>
<td>84.53</td>
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<tr>
<td></td>
<td></td>
<td>University of Chemical Technology and Metallurgy</td>
<td>65.66</td>
<td>78.44</td>
</tr>
<tr>
<td></td>
<td></td>
<td>University of Mining and Geology &quot;St. Ivan Rislki&quot; - Sofia</td>
<td>35.61</td>
<td>49.25</td>
</tr>
<tr>
<td>ICT</td>
<td>Informatics</td>
<td>Sofia University &quot;St. KlimentOhridski&quot;</td>
<td>59.92</td>
<td>85.83</td>
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<tr>
<td></td>
<td></td>
<td>American University in Bulgaria</td>
<td>55.04</td>
<td>44.18</td>
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<tr>
<td></td>
<td></td>
<td>New Bulgarian University</td>
<td>55.26</td>
<td>51.05</td>
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<tr>
<td>Communication and computer science</td>
<td>Technical University of Sofia</td>
<td>Technical University of Sofia</td>
<td>61.9</td>
<td>84.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical University of Varna</td>
<td>60.69</td>
<td>59.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rousse University &quot;Angel Kanchev&quot;</td>
<td>65.86</td>
<td>61.1</td>
</tr>
<tr>
<td>Pharmaceutical Biotechnology</td>
<td>Sofia University &quot;St. KlimentOhridski&quot;</td>
<td>Sofia University &quot;St. KlimentOhridski&quot;</td>
<td>58.56</td>
<td>77.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>University of Food Technology</td>
<td>59.62</td>
<td>56.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>University of Chemical Technology and Metallurgy</td>
<td>42.52</td>
<td>48.82</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field</th>
<th>University Name</th>
<th>Science and Research</th>
<th>Teaching and learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>Sofia University &quot;St. KlimentOhridski&quot;</td>
<td>65.24</td>
<td>73.81</td>
</tr>
<tr>
<td></td>
<td>Trakia University - Stara Zagora</td>
<td>56.8</td>
<td>55.58</td>
</tr>
<tr>
<td></td>
<td>Plovdiv University &quot;PaisiiHilendarski&quot;</td>
<td>48.26</td>
<td>51.92</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>Medical University - Sofia</td>
<td>59.74</td>
<td>66.73</td>
</tr>
<tr>
<td></td>
<td>Medical University - Plovdiv</td>
<td>55.2</td>
<td>38.39</td>
</tr>
<tr>
<td></td>
<td>Medical University &quot;Prof. Dr. ParaskevStoyanov&quot; - Varna</td>
<td>40.19</td>
<td>48.96</td>
</tr>
</tbody>
</table>

Annex 4.2b: Bulgarian University Rankings - Pharmaceutical sector

Annex 4.2c: Bulgarian University Rankings - Food Processing sector

Annex 4.2d: Bulgarian University Rankings - Machinery and Electronics

Annex 4.2e: Bulgarian University Rankings - ICT sector

Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013”, financed under Priority Axis 5 “Technical Assistance” of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
Annex 4.1: Challenges in Allocating and Using STI Funding in Universities

In the case of universities, only a minimal amount is actually earmarked for research. The so-called science subsidy accounted for 2.8 percent share of the state support to universities in 2010. This is a project-based support that should help to cover the basic needs of HEIs for conducting research, producing publications, printing textbooks and scientific research reports. However the amount is insufficient. Allocations are made across all HEIs in installments 50:30:20 percent portions, with the size of allocation depending on the implementation of the approved projects and the performance of individual HEIs with respect to the use of the science subsidy received in the previous year.

Common challenges in allocating and using STI funding in universities are:

- The minimum of 10 percent of budgets going to STI (Law on Higher Education), is not fulfilled. Trying to reach the 10 percent means cutting the budget for salaries and other essentials, which is not feasible.
- The annual state subsidies for universities does not include STI spending needs, and are based on the number of students and planned capital expenditures, however salaries, with the exception of sabbatical leaves for research, should not be considered STI spending.
- STI spending can only include: (i) Salaries covering the actual hours spent in research, and (ii) Direct research costs such as analysis, data gathering and purchase, software, machinery, and lab consumables. The funding for STI often goes to supplying the bare minimum purchasing computers and stationery.
- No distinction between STI spending and other types of spending in accounting principles: Accounting and/or managerial systems have to separate expenses used directly for STI and basic functioning of the universities. Current systems do not allow administrators to quantify the cost of scientific output.
- Rules for state subsidies require public procurement procedures slow down university projects. These public procurement laws apply to all university projects even if the funding comes from private companies, which can be a significant disincentive to private investment in university-based research.
- Lack of long-term STI funding from the government makes it difficult for universities to plan and set priorities and strategies. Currently STI budgets are often cut after they have been approved, making planning difficult.

*Article 91 (7)*

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84 World Bank (2012) Strengthening Higher Education in Bulgaria
85 The remainder of the financing for universities is through: a core subsidy (79 percent) that covers salaries and recurrent expenditure of HEIs; a social subsidy (14 percent) to cover the social expenditure of students, incl. scholarships and dormitories—the size is determined annually in proportion to the number of students enrolled in HEIs; capital subsidy (3.3 percent), covering the capital investment needs of HEIs.
Annex 4.2: Academic careers

Annex 4.4a: Country Annual Average Salary for researchers per level of experience (2006, all currencies in PPS)

Note: The EC Research Directorate (2007) study analyses the average remunerations of researchers per country by normalizing results in terms of the Purchasing Power Standard (PPS). PPS is based on the cost of living per country, allowing multilateral comparison not only within the EU, but also at the international level.
Annex 4.4b: Difference in median gross annual earnings of doctorate holders working as researchers and as non-researchers, 2009

![Graph showing difference in median gross annual earnings of doctorate holders working as researchers and non-researchers, 2009](image)


Annex 4.3: Evaluation methods of national research institutions - international comparison

<table>
<thead>
<tr>
<th>Evaluation of scientific research -- international comparison</th>
<th>United Kingdom</th>
<th>France</th>
<th>Netherlands</th>
<th>Bulgaria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brief description/name of the evaluation exercise</td>
<td>UK Research Assessment Exercise (RAE) 2008 (in 2014 will be replaced by Research Excellence Framework - REF)</td>
<td>Evaluation of Research and Higher Education Institutions</td>
<td>Standard Evaluation Protocol 2009-2015 (SEP) for evaluation of scientific research in the Netherlands</td>
<td>Evaluation of the research units of the Bulgarian Academy of Sciences</td>
</tr>
<tr>
<td>Frequency of the evaluation (ad hoc, multi-annual, annual)</td>
<td>Multi-annual: 2008, 2014</td>
<td>Multi-annual: Every year, the Agency evaluates institutions in one of five regional groups, the year prior to the contractual negotiations with their supervising ministry, so as to give both parties a shared basis for analysis and dialogue.</td>
<td>Multi-annual: every 6 years</td>
<td>Ad hoc, only once</td>
</tr>
<tr>
<td>Date of last evaluation</td>
<td>2008</td>
<td>2012</td>
<td>2009</td>
<td>2009</td>
</tr>
<tr>
<td>Who undertakes the evaluation (internal experts, government-led, external experts, international)</td>
<td>Higher Education Funding Council for England (HEFCE), the Scottish Further and Higher Education Funding Council (SFC), the Higher Education Funding Council for Wales (HEFCW) and the Department for Employment and Learning, Northern Ireland (DEL)</td>
<td>AERES (French Evaluation Agency for Research and Higher Education), peer institutions, experts</td>
<td>Led by Association of Dutch Universities (VSNU), Royal Netherlands Academy of Arts and Sciences (KNAW) and Netherlands Organisation for Scientific Research (NWO), with international external evaluation peer committees</td>
<td>International: Led by European Science Foundation (ESF) and All European Academies (ALLEA) – European Federation of National Academies of Sciences and Humanities</td>
</tr>
<tr>
<td>What institutions are covered (universities, research institutes, both)</td>
<td>Both</td>
<td>Both</td>
<td>Both</td>
<td>Only BAS institutes</td>
</tr>
<tr>
<td>Evaluation of scientific research -- international comparison</td>
<td>United Kingdom</td>
<td>France</td>
<td>Netherlands</td>
<td>Bulgaria</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>----------------</td>
<td>--------</td>
<td>-------------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>What method is used (interviews, expert panels, both)</strong></td>
<td>'Modified' or 'Informed' Peer Review (Industry or those applying research outcomes can be involved in evaluation, i.e. the 'users' are involved)</td>
<td>Self-evaluation by the institution, followed by external, independent, collective and transparent peer evaluation; expert committee's on-site visits; the approved evaluation report is sent to the institutions for amendments.</td>
<td>The information to be presented to the external evaluation committee contains two parts, (i) a self-evaluation report, which includes a SWOT analysis, and (ii) a full set of quantitative information concerning the input and output of the group during six years prior to the evaluation.</td>
<td>(i) Detailed Self-Evaluation Reports (SER) prepared by all BAS Institutes and submitted to Review Monitoring Committee (RMC), and (ii) the on-site visits and interviews by the panels.</td>
</tr>
<tr>
<td><strong>Evaluation criteria that are prioritized:</strong></td>
<td>Basic, applied, mission-oriented, interdisciplinary and multi-disciplinary</td>
<td>Basic, applied, multi-, inter- and trans-disciplinary</td>
<td>Basic, mission-, multi-, inter-, or trans-disciplinary nature</td>
<td>Basic, mission-oriented</td>
</tr>
<tr>
<td><strong>Scientific and technological impact indicators</strong> (Publications, citations, patenting)</td>
<td>All research inputs and outputs: Journal article, Chapter in book, Authored book, Conference contribution, Internet publication, Edited book, Exhibition, Research report for external body, Artifact, Digital or visual media, Scholarly edition, Design, Patent/published patent application.</td>
<td>Publications, lectures and other unpublished oral communications, other scientific reports specific to the field, the production of instruments, resources, methodology.</td>
<td>All research inputs and outputs (patents, scientific articles, health protocols, designs, policy reports, depending on research area). Quality and scientific relevance of the research.</td>
<td>Self-Evaluation Reports (SER) include listing of publications, most important scientific achievements, number of citations, scientific products, inventions and patents produced, patent licenses registered, including individual patents of scientists of the unit; applications, advanced technologies, prototypes.</td>
</tr>
<tr>
<td><strong>Education and training</strong> (no, master's and professional education, PhD level and postdocs)</td>
<td>Development of a future generation of researchers.</td>
<td>Master’s degree trainees (M1 and M2) and doctoral students received in the research institution; monitoring of doctoral students in liaison with doctoral schools and attention to the career opportunities for doctoral graduates; researchers' involvement in setting up Master's training courses.</td>
<td>PhD training - Objectives and institutional embedding; Structure of programs; Supervision; Success rates; Educational resources; Scientific publications and PhD-theses.</td>
<td>PhD level and postdocs; Participation of scientists in the unit in teaching and training.</td>
</tr>
<tr>
<td><strong>International collaboration</strong> (exchanges and seminars, co-publications, joint education/research programs)</td>
<td>Collaborative R&amp;D</td>
<td>National and international collaborative research projects; the existence of collaborations with other laboratories; participation in national and international networks, scientific societies, scientific programming communities; management of collections, series listed at scientific publishers; participation in editorial committees, scientific committees of symposia or conventions, scientific review bodies</td>
<td>Collaborative R&amp;D</td>
<td>International collaboration on scientific projects and publications</td>
</tr>
</tbody>
</table>
## Evaluation of scientific research -- international comparison

<table>
<thead>
<tr>
<th>Evaluation aspect</th>
<th>United Kingdom</th>
<th>France</th>
<th>Netherlands</th>
<th>Bulgaria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Collaboration with private sector (no, soft partnerships, contract R&amp;D, joint R&amp;D, consortia)</strong></td>
<td>Relevance to commerce and industry.</td>
<td>Contracts obtained with non-academic partners (research, publishing contracts, availability of expertise or resources, jointly-funded theses, etc.) and joint responses to invitations to tender; number of business start-ups through the institution's multi-, inter or transdisciplinary experience.</td>
<td>R&amp;D collaboration; collaboration with industry; Research topics planned for the near future and their perspectives.</td>
<td>Soft partnerships - Self-Evaluation reports include: perspectives for strengthening relations with industry and/or other sectors important for the economic development of the country.</td>
</tr>
<tr>
<td><strong>Economic and social impact (technology adoption, productivity, jobs created, public goods)</strong></td>
<td>RAE improved the quality of research outcomes, raised public and government awareness of the excellence of its scientific enterprise.</td>
<td>Introduction of technological transfer support structures; involvement in interface structures; collaboration with cultural institutions (museums, libraries, academies, theatres and opera houses, etc.); participation in cultural events, heritage programs.</td>
<td>Knowledge transfer, contribution of research to important issues and debates in society: behavioral changes of actors or institutions (for example protocols, laws and regulations, curricula).</td>
<td>Score on relevance, understood as socio-economic impact: focusing primarily on service, advice and guidance functions (and including, where appropriate, specific teaching and outreach activities).</td>
</tr>
<tr>
<td><strong>Evaluation led to internal changes (None, reallocation of internal funds, institutional reorganization)</strong></td>
<td>n/a</td>
<td>Institutional reorganization, funding, public disclosure</td>
<td>Improvement of research quality based on an external peer review, including scientific and societal relevance of research, research policy and research management.</td>
<td>Institutional reorganization</td>
</tr>
<tr>
<td><strong>Evaluation results linked to future public funding (directly, indirectly, no)</strong></td>
<td>Directly (establishes high-powered incentives)</td>
<td>Directly</td>
<td>Directly: accountability to the board of research organization, and towards funding agencies, government, society at large.</td>
<td>No</td>
</tr>
</tbody>
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Annex 4.4: Bulgaria in FP7 - Key Facts

**FP7 Key facts and figures**

**Applications:**
As of 2011/03/16, a total of
- 2,014 eligible proposals were submitted in response to 248 FP7 calls for proposals
- involving 2,600 applicants from Bulgaria (0,98% of EU-27*) and
- requesting EUR 404,62m of EC contribution (0,56% of EU-27*)

Among the EU-27* Bulgaria (BG) ranks:
- 20th in terms of number of participants and
- 20th in terms of requested EC contribution

**Success rates:**
- The BG applicant success rate of 16,8% is lower than the EU-27* applicant success rate of 21,5%.
- The BG EC financial contribution success rate of 10,9% is lower than the EU-27* rate of 20,7%.

Specifically, following evaluation and selection, a total of
- 337 proposals were retained for funding (16,7%)
- involving 438 (16,8%) successful applicants from Bulgaria and
- requesting EUR 53,95m (10,9%) of EC financial contribution

Among the EU-27*, Bulgaria (BG) ranks:
- 24th in terms of applicants success rate and
- 26th in terms of EC financial contribution success rate

**Signed grant agreements**
As of 2011/03/16, Bulgaria (BG) participates in
- 292 signed grant agreements
- involving 4,344 participants of which 385 (8,60%) are from Bulgaria
- benefiting from a total of EUR 1,003,70m of EC financial contribution of which EUR 47,09m (4,69%) is dedicated to participants from Bulgaria.

Among the EU-27* in all FP7 signed grant agreements, Bulgaria (BG) ranks:
- 20th in number of participations and
- 21st in budget share

**SME performance and participation**
- The BG SME applicant success rate of 14,15% is lower than the EU-27* SME applicant success rate of 19,33%.
- The BG SME EC financial contribution success rate of 12,80% is lower than the corresponding EU-27* rate of 18,28%.

**Specifically,**
- 926 BG SME applicants requesting EUR 151,81m
- 131 (14,15%) successful SMEs requesting EUR 19,43m (12,80%)

In signed grant agreements, as of 2011/03/16,
- 76 BG SME grant holders, i.o., 10,74% of total BG participation
- EUR 13,10m, i.e., 27,82% of total BG budget share
- Top 3 collaborative links with:
  - UK - United Kingdom (371)
  - DE - Germany (371)
  - IT - Italy (291)
- **GERD as % of GDP**
  - 0,48% 1,83%

*Source: Innovation Union Competitiveness Report 2011*
Chapter 5. Human Capital Formation

A. Overview of the Bulgarian Higher Education System

5.1. Since Bulgaria joined the EU in 2007, its tertiary education system has helped to accelerate its social and economic convergence with the rest of Europe. Despite the achievements over the past two decades, higher education in Bulgaria continues to face challenges with regard to quality, efficiency, and accountability for results. In addition, Bulgaria has one of the most challenging demographic profiles in the EU and the world, with its population expected to decline by 27 percent between 2010 and 2060, ultimately decreasing to almost half of its level at the early days of transition. Bulgarian society is aging rapidly, with the population above working age expected to almost double as a share of total population to 33 percent by 2060 compared to 2010. Most importantly, the population of age 15-24 years is also projected to decline by 41 percent between 2010 and 2060, which will have a direct impact on the tertiary education sector.

5.2. Reducing the convergence gap between Bulgaria and the rest of the EU will require sustained and marked improvements in productivity and a shift to economic activities with higher value-added potential, generated by employees with higher and better skills. Bulgaria’s Europe 2020 agenda and the related strategic documents adopted by the Bulgarian government (the National Reform Program and the Convergence Program) set the ambitious target of increasing the share of the people aged 30–34 with higher education to 36 percent by 2020. With the emerging negative growth in enrollments, however, the achievement of this objective will require: (i) greater effort to enroll those left behind in the age range of 24-34; (ii) improved participation and completion rates for secondary education, (iii) consolidation of the sector to optimize the intake capacity of tertiary institutions; and (iv) improvement in the quality and international reputation of Bulgarian higher education, and pursuit of a higher number of international students enrollments.

5.3. Recent reform initiatives have begun to address some of these issues:

- Amendments to the Academic Staff Development Act in 2010 replaced the ineffective, centralized system for career development with a system providing significant autonomy to HEIs and research institutions to adopt and implement their own staffing policies.

- The Higher Education Act was amended in 2010 and 2011 to allow HEIs to perform research activities on a contractual basis for state and private users as well as for other HEIs; and to partner with other HEIs (local or international) and organizations. These amendments also created the legal basis for the delivery of joint graduate or PhD programs, including through franchise arrangements.
• The funding model has been gradually reoriented toward a stronger focus on HEI performance, starting with a small performance awards envelope in 2011, and further enlarged and refined in 2012. This funding reform followed a major undertaking to collect information on educational outcomes and graduate employment in 2010 and 2011, as part of the Bulgarian Universities Ranking System (BURS) initiative.

• Legislative amendments were passed in the second half of 2011 to establish the foundation for competition in the quality assurance market by allowing ENQA and EQAR member agencies to conduct program evaluations of Bulgarian HEIs, as part of a broader set of revisions of the quality assurance framework in the country.

5.4. Following these reforms, Bulgaria is well positioned to further improve the system by implementing measures to increase the quality, relevance, and efficiency of its tertiary education institutions, and by revisiting the existing models of governance and financing. These elements are central to developing a higher education system capable of imparting the skills and knowledge required to boost the social and economic prosperity of Bulgaria. They are also essential for addressing the significant differences identified by the System of Bulgarian Universities in the quality of research and education processes at Bulgarian institutions.

B. The labor market performance of graduates: To what extent should HEIs be held responsible?

5.5. Assessing the quality of higher education is more challenging due to the lack of data from standardized exams, as are available to assess the quality of secondary education. There are, however, some examples of learning outcomes assessment in higher education.\(^{87}\) In 2011, the OECD launched the Programme for the International Assessment of Adult Competencies (PIAAC), which could serve as a reference; but Bulgaria is not part of the study.\(^{88}\) The World Bank has developed the STEP survey, which provides similar data, and Bulgaria plans to implement a light version of the STEP survey, using

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\(^{86}\) [http://rsvu.mon.bg](http://rsvu.mon.bg)


\(^{88}\) PIAAC is based on interviews of adults aged 16-65 years in their homes – 5 000 in each participating country. PIAAC is assessing the literacy and numeracy skills of participants and their ability to solve problems in technology-rich environments and is collecting a broad range of information from the adults taking the survey, including how their skills are used at work and in other contexts such as the home and the community. For more information see [www.oecd.org/piaac](http://www.oecd.org/piaac).

some items from the cognitive and non-cognitive modules and some from the national student tests. In addition, technical skills have been the focus of a set of sectoral surveys carried out by the Bulgarian Industrial Association.⁹⁰

5.6. Bulgaria is a participant in the Bologna process, which presents quality assurance as a central action line, and this has led to significant changes in Bulgaria’s tertiary education landscape. Key developments have included the institutional reorganization and strengthening of the National Evaluation and Accreditation Agency (NEAA), along with its membership in the European Association for Quality Assurance in Higher Education (ENQA) and the European Quality Assurance Register (EQAR). NEAA has implemented important Bologna-driven activities over the past eight years, including having accredited all of the existing institutions in the system and their programs (a process completed by the end of 2010.) An external review of NEAA published in 2008 indicates that NEAA has demonstrated considerable progress in terms of the establishment of know-how, management, procedures and a firm quality culture. The quality culture in the higher education institutions is, therefore, well-established, but how this quality translates to internationally relative student outcomes remains an area in need of further study.

5.7. Comparisons between Bulgarian graduates and their counterparts abroad are difficult because of the lack of broadly recognized data on the labor market performance of graduates. One possible way to overcome this shortcoming would be to track outcome indicators, such as the earnings of university graduates, for a specific period or over their entire professional life. This methodology is widely used but still much debated, since job performance or income cannot necessarily be attributed to the education of the graduate; and workers can acquire critical cognitive and social skills outside of formal education. Moreover, it takes time for the critical analytical capacity acquired in tertiary education to be converted into job skills.

5.8. The STEP surveys measuring adult skills and competencies will allow for direct assessment of the benefits of education by looking at the differences between the more educated and the less educated. At this point, however, Bulgaria will have to rely on indirect indicators for skills acquired in tertiary education, as direct indicators provided by PIAAC or STEP studies are not yet available. One such set of indicators, as noted above, is the labor market performance of graduates.

5.9. Data for Bulgaria show that, on average, people with tertiary education earn much more than people with secondary education. The chart below shows a cross section of the average earnings of people with tertiary and secondary education across age groups (23-65) in 2006. The data come from the Labor Cost survey of the National Statistical Institute, which covers the entire working population.

⁹⁰ See [www.competencemap.bg](http://www.competencemap.bg)
5.10. The data indicate that people with higher education earn significantly more, and their earnings increase over time (See Box 5.1: Returns to education in Bulgaria).

**Box 5.1: Returns to education in Bulgaria**

Current university graduates in Bulgaria can expect a highly positive net return from their private investments in tertiary education. Projections based on data about the labor market performance of university graduates in the last six years imply a private rate of return to higher education of more than 7 percent a year, and a combined private and public return exceeding 12 percent, which is similar to the rates of return estimated for some developed countries. This makes tertiary education in Bulgaria a good investment on average, but with large differences explained by a variety of factors.

The pertinent question for education policy is how much of the difference in graduate earnings can be explained by the quality of education in a specific institution, and how much by other factors such as program of study, education of the parents, family background, quality of secondary education, the macroeconomic environment, and the changing labor market. A regression analysis based on data from the Bulgarian University Ranking System shows that about 27 percent of the total performance of university graduates on the labor market can be explained by the education of the father (more than the mother, which is used as a predictor in most models) and the scores from the secondary school diploma. Including other factors related to the students’ environment before university, does not improve substantially the explanatory power of the model, as all of them are highly correlated.

The 3D chart below shows the linear relationship between father’s education, scores from the secondary school diploma, and average earnings in Bulgarian currency during the first four years after graduation from tertiary education. The white points represent the raw data averages for each area of study in each institution.

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*Source: Cross section of log income based on data from the 2006 Labor Cost Survey of the NSI*
5.11. By contrast, people with secondary education seem to experience a decrease in income toward the end of their career – a predictable pattern under some economic theories – due to a loss of some abilities as they get older. As this happens faster with in professions that rely on physical force and dexterity over cognitive skills, laborers and even skilled machine operators and craftsmen are typically more affected by declining earnings in their fifties and sixties than employees who rely primarily on analytical skills. This pattern is exactly matched in Bulgaria. A simulation using three waves of the Bulgarian Labor Cost Survey (2002, 2006, and 2010) predicts that incomes of people currently graduating from tertiary education may follow a linear trend of increase until their early sixties. It should be noted that there are some highly qualified professions requiring tertiary education which do not provide very high earnings but have a high rate of social return due to their value to society. The teachers’ profession is

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a typical example. Such professions usually compensate graduates for the loss of potential income by stable career paths and low risk – low variance in earnings.

Figure 5.2: Projections of net returns on tertiary education for current graduates in Bulgaria (BGN/year)

5.12. Results from the OECD Program for International Student Assessment (PISA) surveys from 2000, 2006, and 2009, in which Bulgaria participated, show that Bulgarian 15-year olds in secondary education exhibit a relatively low performance in reading, mathematics, and science. These scores are among the lowest for EU member states in all three domains. The deterioration in the quality of education as measured by PISA could lead to an erosion in workforce skills as new cohorts enter the labor market. The members of the 2000 PISA cohort who continued in tertiary education were likely to have started their active participation in the labor market in the years 2007-2009, depending on their course of study. The 2006 cohort, which had notably low PISA scores, will be coming into the labor market from the beginning of 2013. The 2009 cohort is now graduating from secondary school and part of it will enroll in tertiary education. Based on the existing data, particularly from the Bulgarian University Ranking System (BURNS), it is too early to assess cohort effects on HEI performance, but one important lesson is that what may appear to be a deterioration (or improvement) of the quality of tertiary education might just be explained by different characteristics of successive cohorts.

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5.13. A regression analysis of PISA results confirms a strong positive relationship of secondary education performance and parental education, but the associated predictors related to family and schools explain only part of the performance of graduates. Differences within tertiary education and differences arising from changing circumstances in the labor market are also important factors.

5.14. There is also an across the board increased demand for IT skills related to science, technology, engineering and mathematics (STEM). Digital environment changes the nature of skills required of the workforce. For instance, auto repair workers need these skills since diagnostics are performed using computers. At the same time, there is an enhanced demand for creative skills since these technologies provide for greater creative opportunities and where creative content is a means of differentiating products and services.

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**Box 5.2: e-Skills in Bulgaria**

According to the Digital Agenda for Europe (DAE) framework analysis, over 40% of Bulgarian households that don’t have access to internet found the lack of skills as one of the most important barrier (the majority of this group comprises of ageing population in rural areas and the low level of inclusion among ethnic minorities). Based on Eurostat data, over 10% of the population in Bulgaria has high computer skills compared to the EU average above

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Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013”, financed under Priority Axis 5 “Technical Assistance” of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
25%, while less than 10% of the population has high internet skills compared to the EU average of over 10%. The internet users of Bulgaria are four and a half years behind the EU average in terms of diversification of their online behavior [1]. Another estimate of the importance of these skills is that there are five jobs for every IT position [2].

According to an EC survey, in 2011-2012 on average there were five 8th grade students for each computer in the EU and eleven in Bulgaria. Students in Bulgaria enjoy higher than EU average broadband speeds but there are more students per computer and higher than average percentages in schools that are ‘unconnected’. Nevertheless, the frequency of use of ICT equipment by teachers is close to the EU average and by students is generally above that of other countries, particularly using their own mobile phone for learning in class. There have been relatively high levels of ICT professional development for teachers and, where in place, pedagogical as well as technical support from ICT coordinators in school. This support is reflected in the high ICT use in class [3].

Sources:

5.15. As shown in Figure 5.4, achieving tertiary education has a positive effect on graduate earnings, though at different rates, relative to program of study. Indeed, the choice of area of study is of particular importance for both income and unemployment risks. The figure shows the results of an analysis of the influence of universities on taxable income and unemployment risks. The squares represent the median income of graduates from different universities for up to four years after their graduation. The large rectangles represent the 25th and 75th percentiles. Circles and stars are areas of study that give graduates unusually high or low income potential. Data cover the period 2007-2010. The registration of graduates in the Ministry of Education’s database for higher education, AdminUni, started in 2006, so it is not possible to collect and analyze data for earlier periods. There are many small institutions with just one or a few areas of study. Large institutions cover up to several dozen areas of study, which contributes significantly to the variance in incomes within the same institution. The analysis of variance shows that both the institution and the area of study contribute to the differences in graduate earnings, with the contribution from area of study being slightly higher.
5.16. The link between tertiary education and labor market performance is complex, and consumer demand alone cannot produce the most efficient results. Further, some HEIs are opposed to the idea that they should respond to the needs of the labor market. 94 Nevertheless, evidence shows that institutions of tertiary education can contribute to better labor market outcomes by:

i. Rethinking the areas of study they offer and/or the methods by which they train students. The Ranking System of Bulgarian Universities gives examples of majors that produce a disproportionate number of unemployed graduates, or graduates taking low-quality or low-paid jobs, which do not require tertiary education

ii. Fostering professional (technical and technological) tertiary education, with shorter careers closely aligned with the needs of productive sector.

iii. Development of a qualification framework for technical and technology tertiary education as a mechanism for quality assurance and certification of career).

iv. Linking government financial support for students to program accreditation.

94Several articles appeared in the press and in academic sources explaining that universities cannot be held responsible for the situation on the labor market. See for example the publication of the faculty of Mathematics and Informatics of the Shumen University The New Edition of the Ranking System of Bulgarian Universities, recovered from www.info.fmi.shu-bg.net/von/doc/Rejting_2012.doc, 16.12.2012. The authors argue that regional differences in wages make it unfair to compare universities by the earnings of graduates.
v. Carefully considering the opportunities provided by the local, regional, and national labor markets, and finding areas of cooperation with businesses that create jobs requiring tertiary education.

vi. Providing formal (professional) and informal career development guidance to students as early into their tertiary education as possible, to inform and prepare students about the options available to them and the mechanisms for achieving successful employment outcomes.

vii. Developing mechanisms to provide information to families and students regarding income and employability of individual careers in each HEI.

viii. Being more proactive in organizing student internships with business, and dedicating more attention to the quality of internships. Intensive interaction between academia and the businesses where interns are placed is a key to success. Currently, internships are often poorly organized, resulting in disappointment for students and inefficiency in terms of achieving the goals of an internship – learning from practice, applying academic knowledge to real world situations, and getting to know the labor market and prospective employers.

ix. Providing well-developed and targeted lifelong learning opportunities, to support the reskilling of older workers as well as potential new workers, who may not have been in the labor market before but are interested in accessing skills for the new knowledge economy.

x. Ensuring that the National Qualifications Framework for all academic and professional higher education subjects is publicly available and recognized by all stakeholders – students, academic staff, the private sector, etc.

Box 5.3: Innovative entrepreneurs in the rural area - Norway

Starting your own business in a rural area? In Norway, a successful initiative to boost the number of profitable businesses and innovation projects in the county of Oppland. Entrepreneurs in this area get help to develop their ideas and make them reality. We learned that education and training is an important part of this project. Innovation Norway offers products and services to increase innovation in industry throughout Norway, to help develop the regions and promote Norwegian industry and industrialization, and to market Norway as a tourist destination. The institute aims to release the commercial opportunities of the region by encouraging innovation, internationalization and profile-building. To realize this in a sustainable way, education and training is offered in the development phases or ‘from concept to market’.

First, potential entrepreneurs can participate in a one-day course where they decide about their ‘go – no go’. During this day, the participants receive information about the formal requirements and the personal competences that are necessary in order to be successful. In this way they find out if starting a business is an option for them or not. The course is offered free of charge and no previous knowledge is required. After this first training, potential entrepreneurs are invited to a competence course called ‘Entrepreneurship’, which consists of 30 hours of training and 3 hours of personal guidance. The training includes lectures, group work, discussions and an internet based competence course. This course, which is also offered free of charge, also works as a motor to create a new and valuable network for the budding entrepreneurs. In many cases, these networks have already proved to last much longer than the course itself and they gave a great stimulus in the years following the course. Finally, during the long expected marked introduction phase Innovation Norway offers competence gatherings and mentoring. Important extras are advice for inventors, grants for start-ups and micro credit.

This method, with its combination of training, advice, grants and micro credits, has proved to be successful.
According to a survey held in January 2008, some 70% of the course participants in 2006 and spring 2007 have entered business start-ups, and as many as 70% found the training to be of value to their start-ups. Innovation Norway contributes to the establishment of new enterprises by promoting innovation and entrepreneurship, knowledge dissemination, helping building networks and filling financial gaps. New enterprises have started in rural areas and their presence is a good reason for residents to stay in the area, as well as attracting new residents who feel drawn to rural life.

LILLA – Eighteen good practices for lifelong learning, July 2008

5.17. There is a recognized need for vocational education reform to be incentivized to respond to the right signals coming from the labor market and industry. It is reflected to some extent in the new draft law on school and pre-school education, however, changes in the specific legislation regulating vocational schools will also be necessary. New flexible curricula are needed based on modular training. When long term training is concerned, generic skills should be put first on the program and specialization should come later during the training. Short term training should respond to immediate needs on the labor market but needs that correspond to strategic priorities will remain in the domain of the formal education system including the system of vocational schools.

C. Regional aspects of human capital formation in Bulgaria – territorial and inter-occupational mobility

5.18. The uneven territorial development of the Bulgarian economy is reflected in the concentration of human capital and education facilities. The data suggest that regional development is closely linked to the presence of high-quality educational institutions. Therefore, regional imbalances in Bulgaria’s economic development may be at least partially addressed through the regionalization of high-quality education; i.e., the development of human capital in the regions, which is a more significant factor in growth and specialization than the size of the available workforce.

96Gennaioli (Gennaioli et al.: 2011, 40) based on the analysis of 1500 sub-national regions of the world on the determinants of regional income and labor productivity finds that regional education is the critical determinant of regional development, and the only such determinant that explains a substantial share of regional. Available survey data confirms that regional education influences regional development through education of workers, education of entrepreneurs, and regional externalities. Economic development is due primarily to the level of education (the quality of human capital) in a region, and not to its total quantity (the number of people with some education).
5.19. Bulgaria’s uneven distribution of human capital can be seen both in school education and higher education data. The map above shows the geographic distribution of new university graduates. The darker areas attract more university graduates than the lighter areas. The bright red area is the capital city. The two darker red areas are the districts that include the second and third biggest cities – Plovdiv in the middle of Bulgaria and Varna on the Black sea coast.

**Figure 5.5: Geographic distribution of new university graduates**

Source: Ranking system of Bulgarian Universities

5.20. The capital city attracts a disproportionate share of university graduates, even considering the large population of the capital city. Half of all university graduates in Bulgaria since 2007 have gone to

**Figure 5.6: Percentage of new university graduates moving to the capital, the second and third biggest city and the rest of Bulgaria**

Source: Bulgarian University Ranking System
study/work in Sofia. The districts with the second and third largest urban centers attract university graduates in proportion to their populations – approximately one out of five graduates. The remaining 25 districts, however, attract a relatively low number of university graduates.

5.21. Clearly, urban areas offer better employment for university graduates. While 72 percent of the population lives in urban areas, 92 percent of university graduates are concentrated in urban centers, according to data from the last census (2011). The percentage of university graduates is moderately correlated with the degree of urbanization. However, a town in Bulgaria is defined as a settlement with more than 3500 inhabitants and a certain level of infrastructure development, which inadequately describes the real degree of urbanization in an economically relevant sense. Population density is a much better indicator, and not coincidentally, it proves to be a perfect correlate of attractiveness of the given administrative area for university graduates. Economic theory predicts exactly that – i.e., dense labor markets are expected to attract more high-skill workers. There is almost a perfect linear dependence between the market potential of a region, which is estimated based on the size of the population, and the chance of a tertiary graduate going to work there.

![Figure 5.7: Impact of Market Potential and Share of Tertiary Graduates](image)

Source: BURS for tertiary graduate data and Stoychev (2012) for market potential estimates

5.22. These large urban centers play the role of drivers for the rest of the economy, but this tendency can exacerbate the challenges for regions experiencing economic decline and there is some pressure, therefore, to support territorial cohesion by supporting economic development across the regions.

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97 Market potential figures were taken from Stoychev, K. (2012), Локализационниподходиарегионалноразвитие (Localization approaches in regional development), University Publishing House "St. KlimentOhridski".
5.23. In a schematic example of the economy of a Bulgarian town with 30,000 inhabitants, there is little economic activity, aside from the local administration, school education, and healthcare, that requires a highly skilled labor force. The low value-added services sector is always present, but it creates almost no jobs for people with higher education. The same applies for almost all activities which are typical for the economy of a small town – retail, transport, communications, and maintenance of the technical infrastructure. All these sectors create some jobs for university graduates, but most of the jobs require technical personnel with secondary or lower education. And the percentage of engineering jobs at a traditional plant with predominantly manually operated machines is also relatively low and certainly much lower than the number of university graduates seeking jobs. This spurs the question: which activities could generate real demand for more people with higher education in such a locale?

Box 5.4: Collaborative tools bring together film students and industry - Portugal

In the film and media industry, the European Union (EU) is moving to address long-standing problems faced by the continent failing to reap the true economic rewards from its undoubted creative talent. The film and media industry is operating in an era of change, driven by digital technologies, which are revolutionizing production processes, and the Internet, which is dismantling long-established value chains by enabling direct links between producers and consumers.

Key to this success is improving the relationship between the industry and academia through more cooperative alliances. Academia and industry need to cooperate to help ensure that students are best prepared for careers in the private sector, and that firms can tap into this talent and keep up-to-date with new skills and technologies. However, barriers to improved cooperation must be overcome.

The University of Lusofona in Portugal, the largest privately-owned university in the country and part of a successful group of higher learning institutions in the Portuguese-speaking world, including Brazil and Africa, is leading an EU project to foster creative and commercial success in cinema projects.

The head of the film school believed that academia and industry need to work together, recognizing that both have something to give and to get back. “Not just in terms of technical skills and an entrepreneurial mindset, but also in how productions are conceived, critiqued, and executed by making use of the best talent wherever it is physically located, at every stage of the process”. An opportunity to move this vision forward came when the EU launched a new initiative, called Knowledge Alliances, aimed at improving university-business cooperation to create new multidisciplinary curricula and to promote entrepreneurship within education. With EU funding and using the CISCO collaboration platform and innovations such as WebEx Social, the film school created a common environment where teachers, students, and business could come together.

For its part, industry was concerned that academia does not always understand the skills needed by industry. As part of a privately-owned, international group of institutions, the Lusofona university is used to transferring best practices. In 2010, as part of its e-learning program, Lusofona started to use Cisco WebEx® meetings. The web conferencing solution was well received, as it enabled teaching staff in Portugal, Africa, and Brazil to collaborate virtually to discuss and review plans and content. The university also has a successful experience in working with other European universities and industry on a number of projects.

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5.24. Smart specialization has the potential to reduce regional disparities in the distribution of economic factors, incomes, and quality of life by tapping underutilized potential in all regions\(^9\). It is important, however, to choose the right mix of economic sectors and activities to be supported in each region. This will require a translation of national-level priorities into regional development plans, based on the region’s comparative advantage.

**D. Outflow of human capital from the country and the economic potential of the Bulgarian diaspora**

5.25. It is generally understood that Bulgaria has suffered a significant outflow of qualified people over the last two decades. This is an accurate but insufficient assessment of the situation. Indeed, the data indicate that the process of emigration is not specifically so much a brain drain as it is a “population drain”, where people across all levels of qualifications are emigrating. Brain drain is only one part of the overall economic effect of migration. The shrinking labor force and broader demographic and social trends are also having a strong impact on human capital in Bulgaria\(^10\).

![Figure 5.8: Flows of emigrants from Bulgaria during the period starting in 1989](image)

*Source: National Statistical Institute. Quoted from Markova (2010)*


\(^10\) The democratic transition in 1989 and the removal of the “iron curtain” created a wave of emigration in the first year of transition to democracy and a market economy. Later the annual figures of officially recorded migration settled at about 60,000-70,000. Data after 2007 are not comparable with previous periods because travel to the EU remains mostly unrecorded unless people decide to declare a change of official address, which they rarely do. There are signs that migration has picked up a bit in 2009 but the rise does not seem that important from economic point of view. For further details on migration flows in the 90-ties and after 2000 see Markova, E. (2010), 'Effects of Migration on Sending Countries: lessons from Bulgaria', \*Hellenic Observatory Papers on Greece and Southeast Europe* Gree SE Paper No 35, 1-44.
5.26. Data from the National Statistical Institute do not provide much information on the characteristics of the emigrants beyond their gender. A special survey of the National Statistical Institute from 2008 containing more detailed information shows that emigrants are primarily young people of working age, while children and old people are underrepresented. This is a sign that the process of emigration is having a negative impact on the economy by increasing the dependency ratio of the population and reducing the available workforce.

![Figure 5.9: Age groups of the emigrants from Bulgaria in 2008](image)

Source: National Statistical Institute

5.27. Information from the OECD database of emigrants shows that the process of emigration affects groups with all qualifications.\(^{101}\) If this is put in terms of models which take into account the quality of the workforce measured as proportions of emigrants with different skill levels, it appears that Bulgarian emigration has not had much effect on the supply of human capital. In general, however, emigration rates of better educated people are higher for Bulgaria than the average for upper-middle-income countries, which was 5.2 percent in 2005/2006.

5.28. While highly skilled people may migrate in search of better jobs, many end up with jobs in the new country that are also below their skill level (Widmaier and Dumont: 2011, 5). Historically, this is part of the process of integration into the host county labor market. A very important observation made in the Widmaier and Dumont report is that low-educated foreign-born fare better in the host labor market than their native-born counterparts, but that highly educated migrants have lower employment rates than their native-born counterparts do. This somewhat unexpected conclusion means that it is more difficult to

\(^{101}\) The OECD survey puts the total figure of Bulgarian emigrants in 2005-2006 at 662 thousand. Emigration rates for the population with higher education (8 percent) seem to be even a bit lower than the total emigration rate (8.9 percent). The highest emigration rate from Bulgaria to all countries included in the sample was among people with primary education – 10.5 percent (OECD: 2000, 2).
be integrated into the high end of the host country labor market than in the low end. Thirty percent of immigrants in OECD countries holding a university degree work in intermediate or low-skilled jobs. In Bulgaria, between 40 and 50 percent of native university graduates work in jobs that require, at most, a secondary education.

5.29. Indeed, data on the occupations of Bulgarian immigrants to OECD countries show that only a quarter of them are managers or professionals.

![Figure 5.10: Occupations of Bulgarians who have migrated to OECD member countries by 2006](image)

Source: OECD

5.30. If brain drain is considered any outflow of qualified people regardless of whether they are overrepresented or underrepresented among the emigrants, then the process of brain drain is continuing. However, if brain drain is defined as the disproportional outflow of qualified people, as is assumed by some economic models, then Bulgaria’s apparent brain drain generally mirrors the educational composition of the population. As discussed in Chapter 4, the scientific labor market has been especially affected by this trend, particularly as a result of the wage gap between researcher positions in Bulgaria and those in the rest of Europe.

5.31. The 2011 census shows that 233,000 people have returned from abroad compared to the last census and that this group’s education is skewed towards the higher levels. People with higher education are especially overrepresented in those who repatriate after earlier emigration (see Figure 5.12).

5.32. What the data does not show is whether this is a permanent shift in trend or just a short-term effect from the global economic crisis and temporary lack of opportunities elsewhere. If compared to data provided by the OECD, however, it is clear that returnees tend to have better education than both the population in Bulgaria and the diaspora. Some Bulgarian economists believe that the main reason for the
decrease in net emigration in recent years is that despite the fact that Bulgaria still remains the poorest country in the EU, disparities in unemployment levels have disappeared while disparities in incomes are diminishing\footnote{Георги Ангелов, Звезда. Ванкова. , Иванова, Иванка., (eds.) Българската трудова миграция. Има ли нужда от огпаничения в ЕС?, Институт "Отворено общество" - София, 2011.}.  

**Figure 5.11: Evidence of Brain Circulation in Bulgaria, 2011**

![Graph showing evidence of brain circulation](image)

*Source: National Census 2011*

5.33. There are also encouraging examples of “contractual mobility” instead of geographic mobility. As defined in Wildasin (2000, 75), contractual mobility can be a substitute for geographic mobility, or from another, perspective geographic mobility can be regarded as only one specific case of contractual mobility. There are teams of Bulgarian researchers who manage to sustain local research infrastructure and staff by contracting with companies based in foreign countries, but such examples are still unusual. Repatriation grants given by the National Science Fund have had controversial results--leading to increased publication and patenting activity, but some internationally recognized researchers were not able to reintegrate into the local research community and left Bulgaria again after some period of time.
E. Conclusions and recommendations

5.34. Human capital formation is a complex issue, and policies should be designed and implemented with the direct participation of the following agencies:

a) the Ministry of Labor and Social Policy, as key managing authority for the European Social Fund and the key implementing agency for the National Employment Plan;

b) the National Agency for Vocational Education and Training, as the agency licensing all providers of training and qualification courses for adults outside the system of formal education;

c) the Ministry of Economy and Energy, concerning coordination with the operational programs targeted at the human capital formation (funded from the European Social Fund) and with education and adult training policies in general;

d) the Ministry of Education and Science, as the line ministry responsible for policies on secondary vocational and higher education; and

e) Universities and other autonomous institutes for higher education, both public and private, concerning the possible governance and administration reforms to improve student career planning and adjustments to their curricula, marketing, and overall organization strategies.

5.35. The period from the present until 2020 will be very important for the development of the Bulgarian economy, and education must play a key role in this development. Important changes will have to be introduced in both secondary and tertiary education, and both sectors have already started with the adoption of important new legislation and increased pressure to improve both accessibility and performance. In parallel, Bulgaria will have to create a life-long learning system, also supported by existing legislation, with diversified opportunities for learning and skill acquisition to meet the demands of a knowledge-driven economy. To develop advanced human capital and reverse the brain drain the following measures should be addressed:

a) Make higher education more responsive to the needs of industry

i. It will be important to undertake a specific assessment of human capital needs, and adjust the curriculum and develop programs to meet market demand. A system for skills forecasts needs to be established, which should be based on forecasts concerning the development of the economy. Fortunately, there are currently some projects of this type funded by the EU funds – one such project is implemented by the Bulgarian Industrial Association.

ii. University/business collaboration efforts such as developing courses with industry input and offering scholarships in collaboration with industry should be encouraged. Creation of new clusters can also improve the links of education and training with the business. Clusters can also contribute to the establishment of standards for the competencies required in different professions. The location of vocational schools and relevant university programs can play an important role in the creation of clusters.

iii. It is critical to develop a system for providing information on income and employability of different careers at the level of each HEI. Reliable information on existing and prospective
career opportunities should be made available to graduates from the secondary and tertiary education. Furthermore, incentives for studying in technical and engineering specialties need to be introduced to steer students away from popular areas of study like economics and law where there are clear signs of oversupply.

b) Expand efforts to introduce accountability and improve quality of higher education by incentivizing institutional behavioral change

   i. Establishment of performance-based contracts would align and strengthen linkages between the research capability development and graduate education programs as the third mission of the university.

   ii. Develop a quality assurance and accreditation program based on the development of a qualification framework

c) Adopt a life-long learning system

   iii. Over the medium to long term, the government can make the vision to increase share of the people aged 30-34 with higher education to 36 percent by 2020 a reality by providing continued education for adults to acquire and upgrade the industry-specific skills. The education and qualification paths should be diversified and high quality short-term (from several months to two year) training programs should be created for the different skill segments. Short-term training should generally build only special skills required in a specific industry and related to the use of a specific technology. The introduction of a system for validation of skills obtained outside of traditional schools or vocational programs e.g. programming skills would incentivize on-the-job learning and the development of training courses that are more relevant to the labor market.
ANNEX

Annex 1. Net Returns to Higher Education in Bulgaria

Current university graduates in Bulgaria can be expected to have a highly positive net return from their private investments in tertiary education. Projections based on the data about the labor market performance of university graduates in the last 6 years imply a private rate of return to higher education of more than 7 percent per year and a combined private and public return exceeding 12 percent, which in international comparison is close to the rates of return estimated for some developed countries: 12 percent on average for males and 10 percent for females, starting with rates of return as high as 16 percent for French males and going down to 8 percent for males in Belgium and females in Denmark and the Netherlands and only 5 percent for females in Switzerland\(^1\). The question is to what extent this can be attributed to tertiary education. This makes tertiary education in Bulgaria a good investment on average, but with large differences explained by various factors.

The pertinent question from the education policy perspective is how much of the difference in graduate earnings can be explained by the quality of education in a specific institution. It would be, of course, unfair and even absurd to claim that HEIs can be held fully responsible for the labor market performance of graduates. There are a large number of factors unrelated to tertiary education, which have been shown to influence the labor market performance of graduates. Some of those factors, like the ones related to the family and school, precede tertiary education. Others, like the macroeconomic environment and the changing situation on the labor markets, follow after. Finally there is always an unexplained and unobservable residual, which is often labeled as ‘talent’ in the economic analysis.

Regression analysis based on the data from the Bulgarian University Ranking System shows that about 27 percent of the total performance of university graduates on the labor market can be explained by the education of the father and the scores from the secondary school diploma. Including other factors, related to the environment of the students before their enrollment to the university, does not improve substantially the explanatory power of the model as all of them are highly correlated.

The education of the parents exerts a significant influence on the chances of the child to gain education, meaning that the general pattern is that the level of education will be “inherited” from generation to generation. In Bulgaria there is a strong correlation between the number of years of formal education that the father and the mother of university graduates got. The education of the father, moreover, was found to be a bit more influential in Bulgaria, unlike many other countries where the education of the mother is the best predictor and the one routinely used in economic analyses. Scores from the secondary school diploma do not come from standardized tests like the matriculation exams but from the marks given by the teachers in each school during the school year. So arguably, they may not reflect the full variance in performance, but still they seem to capture a large proportion of the existing differences in capabilities and skills that university students had prior to their enrollment in tertiary education.

\(^{103}\) Åke Andersson (2009), 'Returns to Higher Education’, The Royal Institute of Technology, CESISPaper No 163, 1-32.
The 3D chart below shows the linear relationship between the father’s education, scores from the secondary school diploma and averaged earnings in Bulgarian currency during the first 1-4 years after graduation from the tertiary education. White points represent the raw data averages for each area of study in each institution. The 2D charts show the separate relationship between the diploma score and the education of the father and earnings. Regression results for the diploma scores and the father education are given in the annexes.
Chapter 6. Monitoring and Evaluation

A. Introduction

6.1. Evaluation of the EU’s cohesion policies has traditionally focused on implementation issues rather than on capturing the effects of interventions. Beginning in 2014, the European Commission will require evaluations at the EU, national, and regional level to explore the impact of cohesion policy interventions on citizens. Demand for more comprehensive evaluation is explicitly proposed in the 5th Cohesion Report on Economic, Social and Territorial Cohesion (European Commission (2010)), which recommends that clear and measurable targets and outcome indicators be directly linked to policy interventions. This chapter introduces a monitoring and evaluation framework in line with that proposal (see Annex for details). The framework will be an integral part of all strategy documents (e.g., Regional Smart Specialization Strategy, RIS3) and programs included in the Operational Program-IE.

6.2. Monitoring and evaluation (M&E) is a public management tool that helps policymakers and decision makers track performance and determine the impact of policy interventions. Monitoring provides quantitative and qualitative information on the progress of a policy, program, or project compared to some baseline or objective, and is largely descriptive. Evaluation attempts to provide a causal account of whether interventions are achieving the desired outcomes.

6.3. Monitoring differs from evaluation in two main respects. Monitoring aims to verify that activities are being carried out, funds are being used for the purposes intended, and outcome indicators are evolving in the desired direction. Monitoring is usually carried out by the agents responsible for implementation. On the other hand, evaluation aims to assess why and how the desired effects are being achieved or not achieved. It analyzes the mechanisms leading to results, and also takes account of unintended impacts. Evaluation should be carried out by independent experts, guided closely by those responsible for policy.

6.4. These two activities complement each other. Monitoring provides part of the empirical basis for evaluation, while evaluation may raise the need for improved monitoring indicators. Both monitoring and evaluation need to be anchored in a clear intervention logic. The strategy and each of its programs should clearly define the targeted objectives, and be accompanied by a logical framework showing how the expected outputs will lead to intended outcomes. The novelty of implementing M&E frameworks is the information they provide on the success of implemented policies. The continuous feedback obtained through these tools enable policy makers to respond in a timely manner whether the interventions need to be modified, scaled-up, or quitted which also helps reducing the opportunity and financial costs of implemented policies.

B. Designing M&E Framework

6.5. The first step in preparing an M&E framework is to conduct a needs assessment. Before the decision on funding a policy is made, the feasibility and sustainability of the intervention must be evaluated. This evaluation could be based on case studies, summaries of existing research, lessons learnt.
6.6. The M&E framework should be outcome based. Designing such a framework involves three steps:

- **Defining intervention objectives and the specific types of changes expected.** This process must include consultation and collaboration among all stakeholders to ensure that the right development priorities are identified. The stakeholders can define for policymakers what success would look like, and what intermediate outputs they would find acceptable. The consultation should continue stakeholders agree on realistic outputs and outcomes.

- **Choosing indicators.** Simple and reliable indicators should be used to assess outputs and outcomes. These indicators should satisfy five criteria:
  - **Clear** - precise and unambiguous
  - **Relevant** - appropriate to the subject at hand
  - **Economic** - achievable at a reasonable cost
  - **Adequate** - sufficient to assess performance
  - **Monitorable** - subject to valuation by independent experts.

  These criteria, known collectively as CREAM, are in line with the recommendations of the 5th Cohesion report. The approach to selecting indicators should be minimalist (a small but representative set of indicators), conservative (based on experience, not hypothesis), and realistic (data availability constraints are acknowledged and taken into account).

- **Measuring performance baselines and targets.** For each indicator, a pre-intervention baseline should be established. The outcome targets should be based on those indicators. A comparison of the targeted outcomes with the actual results will help evaluate the performance of the intervention and identify the underlying factors for the success or failure.

6.7. The components of the M&E framework proposed by the European Commission are shown below.
6.8. Outcome indicators and targets must be determined at program level – in the Operational Programs – as well as at project level.

6.9. Each project in the Operational Program is required to have one or more outcome indicators and corresponding outcome targets. A project may aim for more than one outcome if appropriate (as in a multi-sector intervention). One of the tasks at the European level is to aggregate certain information across all programs in order to be accountable to the Council, Parliament, the Court of Auditors and EU citizens on how Cohesion Policy resources are spent. This is the task of common (context) indicators defined at EU level.

6.10. Setting outcome targets can provide an incentive for different stakeholders to share information, take part in the selection of outcomes and corresponding outcome indicators, and to follow up progress towards results. International experience suggests that:

a. Targets should be explicitly linked to the policies and projects being undertaken.

b. Targets should be time bound.

c. Targets should be based on rigorous analytical evidence: in setting them, one should move from a well-established baseline and take into account previous experiences and benchmarks.

d. Depending on the circumstances, targets may be expressed in relative terms (rates of change/improvement) or in absolute terms. When comparing performance across different programs, targets should be expressed as ranges or rate of change rather than as single values.

e. Efforts to achieve targets can stimulate policy learning, so there should be flexibility to revise targets based on implementation experience. Targets should be reviewed and revised, if
necessary, at fixed dates, to allow enough time to experiment, produce verifiable results, and adjust to external changes.

f. Attaching sanctions or financial awards to targets should neither be prevented nor be mandatory; if this choice is made, care should be taken to assess and compensate for possible perverse effects.

g. Target setting should be a key objective of technical assistance aimed at building in-house capacity for implementation and M&E.

**An illustration of input, output and outcome indicators**

6.11. Figure 6.2: shows some typical outputs and outcomes associated with public investment in R&D. This simplified linear representation of the sequence of returns from R&D investment does not show the feedback loops between the different phases and contributions from other policies and external factors. Yet it is useful as a starting point for further discussion.

6.12. In the short term, public investment in R&D leads to a higher number of employed researchers and technicians, who receive further training and acquire additional capabilities throughout the process. Their work may eventually lead to innovative outputs such as publications and patents. The infrastructure and human resources mobilized through public investments may contribute to firms in terms of metrology and quality control, which in turn contribute to improvements in quality of industrial production and technology upgrading. Public R&D also opens opportunities for collaboration between researchers and the business sector, including foreign investors.

6.13. In the medium term, public R&D may affect the behavior of various actors in the innovation process – firms, researchers, academia, and foreign investors – by stimulating additional R&D by private firms, as well as technological collaborations. These new activities may lead to technology upgrading, process and product innovations in firms, and intangible effects such as technology transfer.
Figure 6.2: Expected returns from public R&D investments

Source: Agapitova and Guimon (2012).

6.14. In the long term, new technologies and innovations may spillover across the economy and society. This will eventually lead to productivity increases, structural change, and ultimately to higher-quality jobs and economic growth and development. Of course, this upward sequence is not guaranteed in every instance. Given the risks and high failure rates inherent in R&D, some programs may fail to achieve tangible returns, or the R&D may be successful but not create commercial outcomes.

M&E Framework in Regional Smart Specialization Strategy

6.15. Research and innovation (R&I) strategies for smart specialization (RIS3) are integrated, place-based economic transformation agendas that respond to the development needs of a specific country or region. One of the core properties of R&I strategies is that they are evidence based and include sound monitoring and evaluation systems (European Commission 2012). For the Cohesion Policy, appropriate outcome indicators must capture all the objectives of the smart specialization strategy, to ensure that all stakeholder incentives are correctly aligned, that progress can be effectively monitored, and that adjustments can be made where necessary. The central task, therefore, is to set clear and measurable objectives both at the overall strategy level and for each of its actions. Collectively, the outcome indicators for RIS3 should give a clear picture of the evolution of the regional productive structure towards activities that are globally competitive and have a greater potential for value added.

6.16. Policies to promote smart growth must take account of how R&D and innovation manifest themselves in different regions and sectors. The interactions among R&D, innovation, and growth are
location specific, and these contextual issues should be incorporated explicitly in the design of the Operational Program and associated projects. Setting sector and region specific results indicators will help revealing comparative advantages of these particular sector/regions and allow refining future policy interventions.

6.17. The notion of smart specialization, as discussed in Foray et al. (2009), implies that regions are able to identify, through an entrepreneurial process, the areas where they can better innovate and build up international comparative advantages. This is likely to take different forms depending on whether the region is already included in the worldwide circulation of knowledge (whether it has a knowledge hub), or has an established industrial base (industrial production zones), and/or a lagging productive sector (so-called peripheral regions). This typology of regional innovation capacity is based on OECD (2010a), and is quite close to the classifications in Tödtling and Trippl (2005). This categorization also relates to OECD’s (2010b) classification of regional innovation policies.

6.18. As discussed in DG Regio (2010) achieving the EU 2020 objective of “Improving the conditions for innovation, research and development” involves four areas of concentration: research and development, promoting innovation and smart specialization, enhancing accessibility to and use of quality ICT, and removing obstacles to growth of SMEs. Through iterative consultation and collaboration with stakeholders, these priorities should be tailored according to the needs and priorities of Bulgaria.

Possible Additional Indicators for Innovation Policy Priorities in the Smart Specialization Strategy and Operational Program on Innovation and Competitiveness 2014-2020

6.19. A well-structured M&E framework implemented in the 3S and OPIC will help with discovering which instruments work in Bulgaria and give opportunities to re-design those that do not work effectively. A sample of indicator choices based on the priority areas identified in the NRP and as discussed in the outline of RIS3 are listed in Table 6.1, Table 6.2 and Table 6.3. These indicators complement the indicators in the operational program and action plan addressing the issues discussed above on existing indicators. The tables do not provide a comprehensive list of indicators and should be seen as suggestive of how the current list can be improved.

6.20. A particular interest of the smart specialization strategy is the focus on understanding the differences across regions. Most of the indicators can be collected either for a particular region or for the priority sectors clustered in that region. For example, one of the priority sectors identified in Bulgaria is ICT. An ICT indicator could look at either R&D expenditure per worker in the ICT sector compared to country average; or expenditure per worker in a particular region compared to the country average.

104 A fifth thematic priority, “Removing bottlenecks in key network infrastructures,” is usually included under this objective.
6.21. In the tables that follow, the indicators in italics address the regional or sectoral dimensions of the monitoring and evaluation framework.

**Governance of Innovation Policy**

6.22. Long term goal: Achieving effective governance of innovation policy

*Table 6.1: Suggested indicators for governance of innovation policy*

<table>
<thead>
<tr>
<th>Objective</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Formation of National Innovation Board and its secretariat</td>
<td>Regulations</td>
</tr>
<tr>
<td>2  Development of Innovation policy</td>
<td>Implementation of Law on Innovation</td>
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<tr>
<td></td>
<td>Adoption and implementation of National Strategy for the</td>
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<td></td>
<td>Development of Scientific Research 2020</td>
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<td></td>
<td>Preparation of national strategy for creative industries</td>
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<tr>
<td></td>
<td>Monitoring the agencies responsible from implementation of RIS3</td>
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</tbody>
</table>

**Research Institutions and Human Capital Development**

6.23. Long term goal: Strengthening the research and human capital base

*Table 6.2: Suggested indicators for research institutions and human capital development*

<table>
<thead>
<tr>
<th>Objective</th>
<th>Indicator</th>
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</thead>
<tbody>
<tr>
<td>1  Increase collaboration between research organizations and businesses</td>
<td>Amount spent on R&amp;D projects for collaboration between research organizations and businesses</td>
</tr>
<tr>
<td></td>
<td>Additional euro spent by firms on R&amp;D on collaboration projects between PRO and businesses</td>
</tr>
<tr>
<td></td>
<td>Number of researchers involved in projects with businesses</td>
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<td></td>
<td>Number of joint publications by researchers from PRO and businesses per million inhabitants</td>
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<tr>
<td></td>
<td>Number of spin-off companies from PROs</td>
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<td></td>
<td>Share of PRO income from patents and licensing revenues as a share of total PRO income</td>
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<td></td>
<td>Share of applied research projects in total activities of research institutions</td>
</tr>
<tr>
<td></td>
<td><em>Share of applied research projects in total activities of research institutions in a priority sector (e.g. ICT) with respect to country average</em></td>
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<td>Outcome Area</td>
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<tr>
<td>2</td>
<td>Increase Cooperation with R&amp;D institutes in Europe and globally</td>
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<tr>
<td>3</td>
<td>Increase quality of research and quantity of researchers in public research organizations</td>
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Developing Business Innovation Ecosystem

6.24. Long term goal: Creating a facilitative business environment to spur innovation, growth and economic development

Table 6.3: Suggested indicators for developing the business innovation ecosystem

<table>
<thead>
<tr>
<th>Objective</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Increase scientific and innovative products produced in centers of excellence (TTOs, science parks, incubators, clusters etc.)</td>
</tr>
<tr>
<td></td>
<td>Number of projects completed under National Roadmap for Scientific Infrastructure</td>
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<td></td>
<td>Number of research and entrepreneurship centers in universities</td>
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<td></td>
<td>Number of students trained in these centers</td>
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<td></td>
<td>Number of projects supported by these centers</td>
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<td></td>
<td>Number and value of commercialization agreements made between TTOs and the industry</td>
</tr>
<tr>
<td></td>
<td>Number and value of commercialization agreements made between TTOs and the businesses in priority sectors (as a part of smart specialization strategy)</td>
</tr>
<tr>
<td></td>
<td>Number of new or significantly improved science and technology centers</td>
</tr>
<tr>
<td></td>
<td>Number of projects funded in these centers</td>
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<tr>
<td></td>
<td>Total value of projects funded in these centers</td>
</tr>
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<td></td>
<td>Number of product/process innovations introduced in these centers</td>
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<td></td>
<td>Number of patent applications from these centers</td>
</tr>
<tr>
<td></td>
<td>Growth rate of employment or value added of the tenants with respect regional average of similar firms</td>
</tr>
<tr>
<td></td>
<td>Percentage of running time for which installed equipment</td>
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<tr>
<td>Number</td>
<td>Objective</td>
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<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Increase international engagements and foreign collaboration</td>
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<tr>
<td>2</td>
<td>Increase international engagements and foreign collaboration</td>
</tr>
<tr>
<td>3</td>
<td>Promotion of R&amp;D activities, commercialization of innovation, and smart specialization</td>
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<tr>
<td>4</td>
<td>Increase cooperation among business firms and with PROs</td>
</tr>
<tr>
<td>5</td>
<td>Fostering creation of new firms in smart innovation</td>
</tr>
</tbody>
</table>
specialization | Entry rate of firms in priority sectors  
Growth of employment in knowledge intensive sectors

| 6 Increasing industrial R&D | R&D expenditure per worker  
R&D expenditure per worker in priority sectors (pharmaceutical sector) |
| 7 Promoting internationalization of firms due to advantages of smart specialization | Share of first-time exporters (systematically) or first-time foreign investors due to the project.

6.25. There are variety of data sources that can be utilized to monitor and evaluate a program and its components. Some of these sources are presented in the annex.

**Case Study: M&E Framework Used in the Unity through Knowledge (UKF) Program of Croatia**

6.26. From 2006 through 2011, the World Bank implemented a science and technology project in Croatia aimed at enabling research and development institutions to commercialize research outputs, and at increasing the ability of enterprises, particularly SMEs, to invest in research and development activities. One of the project components was the introduction of the EUR5.1 million UKF initiative, the objective of which was to strengthen the research networks of Croatian scientists.

6.27. An M&E framework was implemented throughout the project. The indicators chosen, the targets set, and how the results were interpreted are presented here to shed some light on how an M&E framework should be designed.

6.28. Three programs were developed under the UKF. The **Cooperability Program** supported joint research projects of Croatian scientists in and outside of Croatia, with the goal of encouraging scientific research in Croatian companies and institutions. The **Connectivity Program** supported the international mobility of Croatian professionals and scientists, to enhance the flow of knowledge and skills in Croatia. The **Young Researchers and Professionals Program** supported the professional advancement of young researchers and facilitated their cooperation with international institutions and the business sector, to prepare them to take the lead in future R&D projects.

6.29. The output indicators used to monitor the programs are presented in Table 6.4.

**Table 6.4: Output Indicators for UKF programs**

<table>
<thead>
<tr>
<th>Output Indicators</th>
<th>Baseline 2006</th>
<th>Actual 2008</th>
<th>Actual May 2011</th>
<th>Target May 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of projects (total)</td>
<td>None</td>
<td>38</td>
<td>91</td>
<td>50</td>
</tr>
<tr>
<td>Projects with Croatians living</td>
<td>None</td>
<td>18</td>
<td>37</td>
<td>30</td>
</tr>
</tbody>
</table>
Projects involving cooperation with the industry | None | 8 | 28 | 15

Projects with young scientists | None | 18 | 60 | 15

Projects successfully completed (as evaluated by UKF evaluation committee) | None | 2 | 59 | 30

6.30. The UKF programs had the following significant outcomes:

a. Transfer of technology to, and new technologies developed by, Croatian research institutions. Ninety-one projects were implemented. Based on 28 completed projects (the rest is on-going), 30 new technologies were transferred to Croatian institutions, and 24 new technologies were developed by Croatian institutions.

b. An additional EUR1 million and EUR784,000 in matching funds were mobilized by foreign research institutions and Croatian institutions participating in the projects. This indicator shows the additionality generated by the program.

c. Five hundred fifty-four researchers and 260 institutions collaborated in the projects. Of these, 166 were foreign researchers (41 from the Diaspora) from 133 reputable foreign basic scientific research institutions, including Stanford University, the Mack-Planck-Institute for Molecular Cell Biology and Genetics, the Institute of Biochemistry II of Goethe University Medical School, and the Swiss Federal Institute of Technology Lausanne (EPFL).

d. Fifty-three projects, amounting to EUR2.5 million, involved cooperation with industry and mobilized an additional EUR655,000 from private funds.

e. The Croatian science and technology community increased its capacity to absorb EU funds. Thirty-one UKF projects went on to receive EU 7th Framework Program funds – double the success rate (16 percent) of non-UKF projects.

f. For an investment of EUR2.8, the UKF projects attracted EUR6.4 million in EU FP7 funds.

g. The programs raised the quality and profile of Croatian scientific and research projects. Based on 28 completed projects, the UKF programs had more than 180 papers published in leading scientific journals – a key indicator of excellence. Four of the papers were published in the two highest ranking journals, Nature and Science.

C. Impact Evaluation: Not Just Monitoring and Evaluation

6.31. There are two types of evaluations of an organization’s program: causal or non-causal. Impact evaluation goes beyond monitoring and evaluation activities by identifying the changes in outcomes that are generated by the program itself. For example, one might observe that after subsidies were provided to researchers to work with companies on R&D, the number of patents increased. This would be observable...
through monitoring and evaluation. However, if one does not know how many patents there would have been in the absence of the subsidy program – the counterfactual – one cannot say whether the patents increased because of the program, or would have increased in any case. Impact evaluation complements the efforts to monitor and evaluate projects by allowing one to say whether a program was directly responsible for an observed outcome.

6.32. The diagram below illustrates another example. Suppose it is observed that after a program provided matching grants for R&D, the R&D investment of recipient companies actually fell. Thus it would appear as if the matching grants program were responsible for the decrease. However, perhaps there was an even greater decline in R&D investments across companies that did not receive the matching grants, due to an external factor such as a recession. Monitoring would suggest that the matching grants program decreased investment, whereas an impact evaluation would rightly show that the grants program increased investment.

![Figure 6.3: Monitoring Alone Can Produce Misleading Results](image)

6.33. Impact evaluation is more expensive and time-consuming than non-causal monitoring and evaluation; but without it, one cannot know the actual effects of a program. Impact evaluation may, therefore, be the more appropriate tool when the program is:

- **Innovative** – the program is testing a new, promising approach.
- **Replicable** – the program has the potential to be scaled up or applied in a different setting.
- **Strategically relevant** – the program is a flagship initiative, requires substantial resources, has the potential to cover a large number of people, or could generate substantial savings.
- **Untested** – little is known about the effectiveness of the program, globally or in a particular context.

6.34. Few impact evaluations have been done of R&D support schemes, and it is a topic of great strategic importance, so it will be important to learn from impact evaluation which are the best methods going forward.

D. The Value of Impact Evaluation

6.35. Impact evaluation can reduce the risk that the project will not be successful, by helping to identify the most effective mechanisms for achieving a particular objective, and ensuring that learning from experience is incorporated into the project as it progresses.

Figure 6.4: Impact evaluation can reduce the risk that a project will not be successful

6.36. In Mozambique, for example, an impact evaluation showed that imposing deadlines for grant applications, rather than accepting them on a rolling basis, increased applications several times over. A higher number of applications often translates into a higher-quality pool of applicants, as in the Mozambique case, which in turn results in better outcomes. If one knows early on that this small implementation detail can change program results so dramatically, one can ensure that all future iterations of the program take advantage of this more effective implementation strategy.

6.37. Apart from improving later iterations of a program, impact evaluation can also improve the quality of a current program. In assessing the effects of impact evaluation on project performance, the World Bank found that ongoing projects for which an impact evaluation had been carried out disbursed

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30 percent more by mid-term review. This suggests that the implementation process was itself aided by the impact evaluation.

6.38. Finally, impact evaluation is a public good that can contribute to global knowledge about the likely effects of similar programs.

A. Testing Program Variations

6.39. Impact evaluation can be particularly valuable when testing different program variations to see which are most effective for specific purposes. Some concrete examples are given below.

6.40. First, suppose a government is planning a grants scheme to support R&D. It could provide these grants to private firms or to academic researchers. If it provides the grants to private firms, it could require these firms to partner with academic researchers, or it could provide the grants unconditionally. Similarly, if it provides the grants to academics, it could require the academics to locate a private sector partner or it could provide the funds unconditionally. Any assumption about which way is best could easily tested in practice by allocating grants in different ways – these are called different “treatment arms.” This situation is represented schematically below.

6.41. Similarly, different aspects of the application process can be tested to determine which selection criteria will attract the highest quality companies or academic researchers; i.e., those most likely to successful if given the grant.

Figure 6.5: Testing Different Ways of Disbursing Grants for R&D

6.42. Second, a technology park is being developed to bring together the benefits of human and physical capital. These benefits could be distributed in different ways. First, there are different ways of selecting the tenants of the park. One way could be to target particular sectors, narrowly defined, under the rationale that the closer the fields of activity, the greater the spillover effects. But perhaps there are
actually more spillovers among those with slightly different skills, so it would be preferable to target those sectors defined more broadly. Or perhaps the aim is not to pick winners in terms of sectors, but to allow the market to decide by letting anyone rent space. For each of these possible allocations, contracts could be signed with whichever companies pay first, or applications could be collected and the tenants then selected based on their likely synergies. The next figure illustrates these delineations.

Figure 6.6: Testing different ways of selecting entrants to a technology park

6.43. Finally, suppose the goal is to increase collaboration between private sector firms and academic researchers. A scheme is designed to give the academics grants for joint research. The scheme could also provide mentoring and networking activities to help academics and private firms identify possible areas for joint work, on the assumption that they lack information. The amount and intensity of these mentoring and networking activities could also be varied to determine which approach is most successful.

6.44. As these examples show, in many cases a program can be tweaked to test which way of delivering it is most effective. Funds could then be allocated more efficiently for the next round of the program, potentially resulting in great cost savings. The Annex discusses ways of integrating impact evaluation seamlessly within programs. The next section illustrates, presenting some specific examples of how impact evaluation has been used in the European Union to evaluate the effects of innovation programs.
E. Impact Evaluation in the EU

6.45. Impact evaluation has become an expected part of programs in the EU. This section describes an extended case study of an impact evaluation carried out by the United Kingdom to assess the performance of an innovation program. The discussion then focuses on best practices, and on lessons learned from the impact evaluation that will contribute to future programs.

Case Study: Background

6.46. In the UK, the Technology Strategy Board, in charge of stimulating innovation, was conducting a Collaborative Research and Development Programme (CR&D) to fund collaborations between academics and the private sector for R&D.106 The funds were to be used to explore the technological and commercial feasibility of innovative ideas, and to develop prototypes of potential innovative products and services. The CR&D program was premised on the idea that businesses, academics, and financiers do not collaborate on innovative projects because of risk aversion, a lack of information, and coordination problems.

6.47. Following its general practice, the Technology Strategy Board commissioned an impact evaluation by an external consultant, PACEC. As part of their contract, PACEC also helped to define a set of outcome measures for monitoring.

Case Study: Best Practices

6.48. For its impact evaluation, PACEC surveyed and interviewed 337 CR&D participants that had a project approved in 2004-2009, and 206 CR&D applicants that did not receive funding but appeared

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106 Descriptions of the program, evaluation and results reported in this section are drawn from PACEC, 2011.
otherwise similar to the group that did. This follows the “matching” method described earlier; a sub-optimal method but one which must be used when other methods are infeasible given programmatic or political constraints. As part of this method, it is important to show that the group that received funding is similar in all relevant aspects to the group that did not receive funding except for having received the funding. This is always difficult to prove in practice, but often when making a decision on which projects to fund, a rating scheme is used, and then one can look at the applicants who just barely received funding with those who just barely did not (moving to a “regression discontinuity” design). While this is not the approach PACEC used, it is a best practice when there is a large number of applicants right around the cut-off threshold.

6.49. How many applicants are needed for the impact evaluation depends on the size of the effect one expects to observe – the bigger the effect, the fewer the number of funded and unfunded projects needed to capture the effects. Other factors also affect the number needed. In particular, suppose one wants to observe the effect of the interaction between two factors – for example, what the effect of the program is by company size or by company age. Then one would need to ensure a large enough sample in each subgroup: large companies that received the grant; small companies that received the grant; large companies that did not receive the grant; and small companies that did not receive the grant. Overall, one must have a relatively large sample. PACEC’s total sample of 543 companies would usually be large enough to capture relatively small effects.

**Case Study: Lessons Learned**

6.50. What were the results of the CR&D program? The impact evaluation showed that the results were very promising. The CR&D scheme appeared to have had an average gross value added of £6.71 per £1 spent. However, this estimate hides a large amount of heterogeneity in outcomes across the different types of programs supported. First, grants appeared to be most effective when relatively small. Grants of less than £250k had the greatest return per £1 spent (£10.96 per £1 in gross value added, on average), closely followed by grants between £250-749k (£10.01). Both types of grants were almost four times more efficient than grants over £750k (£2.34). Those projects with four or five partners performed better (estimated £8.91 in gross value added per £1 spent) than either those with only two or three partners (£4.81) or those with six or more partners (£6.57). Finally, the projects that were funded were divided into two groups: those that focused on more basic research that enabled later technologies; and those that focused on market-driven research for particular applications. Returns were similar for basic and more market-driven research. The bottom line is that by looking for differences in results within a program, one can change the program to exploit these differences and maximize effectiveness, potentially multiplying the effects many times over.
B. Impact Evaluation of Smart Specialization Instruments

6.51. This section presents different practices and implementation designs that could be tested within a given smart specialization instrument. Determining which practices and designs to test will depend on the context of the program.

- **Impact Evaluation of Incubators and Accelerators**

6.52. Normally, one would do an impact evaluation by comparing the performance of firms in some areas that did not receive support for an incubator or accelerator with firms in areas that did – either in terms of geographic areas or sectors. However, since impact evaluation requires a large sample size, and there will only be a few incubators and accelerators that are created, we need to use an alternative approach.

6.53. Instead of basing the impact evaluation around a handful of incubators and accelerators, one can base the impact evaluation around a much larger number of firms. We can do this by providing different incentives to different firms that change their likelihood of taking advantage of the incubator or accelerator program. These different incentives can be as simple as providing extra information or could involve differential levels of co-financing or other benefits. The second, while more complicated, would have the additional advantage in helping discern the optimal level of co-financing or other benefits for the incubators / accelerators to offer.

6.54. Impact evaluation relies on identifying a control group which did not receive any benefits but is similar in all other ways to the group which received benefits. For this reason, if place in the incubators and accelerators is limited, we cannot simply give a space to the best firms and then compare those best firms with the firms that did not win a place in the incubators and accelerators. Those which did not win a
place might have performed differently even if they had been accepted into the incubator or accelerator program.

6.55. Instead, the impact evaluation can take one of several approaches:

- Provide different information to different firms on a randomized basis. For example, make a list of all eligible firms and send an information package and phone half of the firms on the list. Again, particular selection of some firms over others would bias the results, but providing more information to some firms is a relatively low incentive and there is good reason for doing it.

- Provide different benefits to different firms, in at least one of two ways:
  
  o Firms should pass a certain set of criteria in order to receive benefits, but once they meet those criteria, some of the benefits can be randomized above that threshold. Again, the additional advantage of this approach is that this would help to determine the optimal level of benefits;

  o Firms could be evaluated for acceptance to the incubator / accelerator through more than one evaluation scheme, with random assignment to one of several evaluation schemes. As the program manager perhaps would need to learn through experience which firms are most likely to increase sales as a result of the support, the program manager might start with more than one evaluation scheme to determine how much time to devote to each firm, evaluating each firm according to a randomly selected evaluation scheme. As an example, suppose there were two evaluation schemes, A and B, and each firm was randomly assigned to one of the schemes. Suppose there is some rubric used to determine which firms get particularly intensive care. We could compare the outcomes of those firms which did not qualify for this under scheme A but would have qualified under scheme B with the outcomes of those firms that qualified under scheme B, and vice versa. An advantage of this technique is that it would also help the program manager to learn which selection criteria are selecting the best firms.

- **Impact Evaluation of Vouchers and Small Matching Grants**

6.56. Each type of program has its potential advantages and disadvantages, so it is not clear *a priori* which program will obtain better outcomes. Vouchers can be disbursed more quickly than matching grants, as they are essentially automatic. The selection criteria are more rigorous for matching grants, so the applications tend to take more time to evaluate, increasing the time between developing the proposal and being able to implement it. At the same time, the quality of the selected projects may be better. Matching grants also often require more of an investment from the firm. Requiring investment from the firm theoretically leads to better proposals and better implementation. However, if there is a lack of access to credit, firms may not be able to finance themselves as much as they need.
6.57. Several approaches can be compared through rigorous impact evaluation:

i. Traditional small matching grants;

ii. Vouchers with a contribution from the firm / small matching grants with quick disbursement;

iii. Vouchers with no contribution from the firm;

6.58. Evaluating all of these types of projects allows us to distinguish between the benefits of disbursing quickly and providing a greater percent of co-financing. One could instead do an impact evaluation of only one or two of these kinds of programs, but one would then lose the ability to distinguish between potential causes of the results. In order to know why an instrument is performing better than another, we need to isolate the potential causes as best as possible.

6.59. The table below summarizes the characteristics of the different instruments. One could compare the outcomes of firms that received vouchers requiring low co-financing with the outcomes of firms that received vouchers requiring high co-financing to determine the effects of different levels of co-financing. At the same time, one could compare the outcomes of the firms that received vouchers requiring high co-financing with the outcomes of the firms that received matching grants with the same amount of co-financing but after undergoing a lengthier and more in-depth selection process. This would isolate the benefits of different selection and disbursement methods.

<table>
<thead>
<tr>
<th>Low firm contribution</th>
<th>Quick disbursement, few selection criteria</th>
<th>Slow disbursement, many selection criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vouchers with low contribution from the firm</td>
<td>Vouchers with high contribution from the firm / small matching grants with quick disbursement</td>
<td>Traditional small matching grants</td>
</tr>
</tbody>
</table>

6.60. Since impact evaluation relies on identifying a control group which did not receive any benefits but is similar in all other ways to the group which received benefits, we would also need a control group of firms which were similar to those that received vouchers or matching grants but did not receive them. Similarly, in order to properly compare the outcomes of firms which received vouchers with firms that received matching grants, we need to be sure that the firms themselves were similar. Even though matching grants apply additional selection criteria, we would like the applicant pool to look similar between those firms applying for vouchers and those firms applying for matching grants.

6.61. To this end, there are several methods one could use to conduct the impact evaluation.

6.62. The most straightforward thing to do would be to randomly assign firms to one of several groups to receive different kinds of vouchers requiring different amounts of co-financing or to undergo different kinds of selection criteria. While this would be a hassle to firms at the beginning, it would provide a lot of
useful information to the government very quickly about how the schemes should be tailored for best effect. Some firms would drop out of the selection process after they were assigned to one of the groups, but this in itself would be informative and could be adjusted for in the analysis.

6.63. If randomization across more than one kind of program is not feasible, alternative options exist but results would be less trustworthy. The rest of this note assumes the impact evaluation proceeds to use randomization, but the practical requirements for the evaluation in terms of personnel and budget will be somewhat similar regardless of the method used.

6.64. Matching grants and incubator/accelerator programs are similar in that they both provide support through an application process. Thus they share common issues subject to testing:

- **Broad targeting versus narrow targeting or no targeting.** What kind of targeting produces the best results – extending the program to certain sectors, certain sub-sectors, or to everyone regardless of sector?
- **Different application evaluation schemes: external consulting firm versus in-house.** Who evaluates applications better? The government agency in charge of the program, or an external private consulting firm?
- **Different application evaluation schemes: evaluating applications on a rolling basis versus at deadlines.** Is it better to evaluate applications on a first-come, first-serve basis or after a certain number of applications are accepted?
- **Different application requirements.** What will the firm be required to show in order to receive program benefits, in terms of e.g., size, age, revenues?
- **Different co-financing levels.** Should the scheme provide a certain fixed amount or a percent of a project’s cost? What fixed amount or percent of the project’s total cost should be borne by the government?
- **Different timing of the grant.** At what point should the money disburse?
- **Different auditing levels of assessors or of projects.** What is the optimal amount of auditing of assessors or of projects?
- **Different program requirements.** Should firms receiving the benefits be required to collaborate with academic researchers? Should the grant be given to the firms or the academics? Should firms be required to have an international partner?

6.65. To conclude, there are many ways of designing an impact evaluation. Some ways will be easier to integrate in an existing program, and this will depend on the specific circumstances of that program. Impact evaluations are particularly useful when they go beyond asking “what” the impact of the program was and focus on the “how”. With the knowledge gained by testing different program variations, future iterations of each program can be made much more effective at encouraging innovation.
F. Conclusions and Recommendations

6.66. Monitoring and Evaluation together with Impact Evaluation are important tools that contribute to the success of policies proposed in smart specialization strategies. They help discover how each intervention works and whether they should be removed, modified, or are profitable enough to be scaled up, giving policy makers an opportunity to re-design their programs through continuous feedback loops. This mitigates the risk that a program will be unsuccessful.

6.67. Monitoring and Evaluation and Impact Evaluation tools need to be incorporated into each program at the design phase in order to get the most benefit from using them. They will then streamline the process of identifying the priority sectors, regions, and policy instruments and contribute significantly to the success of implemented policies. To improve the effectiveness of Monitoring and Evaluation design the following should be noted:

6.68. **Expand the number of indicators for better measurement of progress towards objectives.** In the Operational Program document, although there are many output indicators, too few results (outcome) indicators are presented. For Priority Axis (PA) I, there is only one results indicator, and for PA 2 and 3 there are no results indicators. Output and results indicators should be balanced among the list of indicators. The indicator list has many indicators that are not closely linked with the results of specific interventions which obscure monitoring and evaluation of procedures and assessment of their impact.

6.69. **Include indicators that address additionality.** Some results indicators should be designed to capture the extent to which a program creates additional investments – or may be crowding out private R&D investments. For example, in research collaboration projects between public research organizations and the business sector, the indicator could measure how much R&D investment is generated by the business sector. In research collaborations with foreign scientists/institutions, the indicator could measure how much R&D investment is contributed by foreigners. For publicly supported research projects, the indicator could measure how many of those projects are later accepted in the Horizon 2020 programs.

6.70. **Indicators and their targets must be set at both program and procedure levels.** Operational programs have many indicators that provide information useful for program monitoring. However, most of these indicators are set at the program’s priority axes levels, some of which are cover several procedures. For example, under PA1, there are six programs (called as procedures) that aim to support a wide range of innovation projects as they move from the prototyping stage to commercialization. These indicators need to be defined more narrowly at each procedure level, to help identify bottlenecks in the design and implementation at that stage in the process. The number of products/processes/designs developed in each relevant procedure should be included in the indicators list. Moreover, periodical evaluation reports that address the additionality generated at each procedure level and priority axis level would be very informative.

6.71. **Consolidate similar indicators when formulating the action plan.** For example, a variety of indicators on the utilization of a super-computing center, or on efforts to network in European markets
through programs like EUREKA, EUROSTARS, or Enterprise Europe Network, could be a single indicator in the action plan.

6.72. **Include indicators that capture differences in how innovation is promoted across regions and priority sectors.** The current action plan for the National Reform Program (NRP) lacks any such indicators. Nor does the action plan make use of well-established human development indicators. Some suggestions are provided in the Smart Specialization Strategy Report prepared for Bulgaria by the World Bank.

6.73. **In addition to regular monitoring visits during the project life, MEE guidelines require that firms should be visited three months to three years after completion of the project.** Evaluating the project three years later makes it difficult to isolate the impact of the policy intervention from other external factors.

6.74. **Improving the way programs are structured might accelerate their implementation.** Projects supported under PA1 address a wide range of issues, requiring a large pool of experts. These experts could be selected using the public procurement system, and they could constitute the program evaluation committee.

6.75. **Impact evaluation should be considered when a program is innovative, replicable, strategically relevant, untested or influential.** Impact evaluations can more accurately pinpoint the effects of a program and identify ways it can be improved through iterative learning.

6.76. **Better coordination between MEE and the Ministry of Finance would be helpful in evaluating the success of each operational program.** The Ministry of Finance prepares the NRP, which includes a detailed action plan with a rich set of indicators for each national target. Some of these indicators are already monitored by MEE, but many have zero or missing current value entries. For example, the “Development of innovations by start-up enterprises” indicator shows a zero current value in the action plan, whereas according to MEE records, 52 out of the 243 submitted proposals have already been contracted. Implementation of a governing body for the overall innovation ecosystem in Bulgaria as suggested in the proposed regional smart specialization strategy document would resolve this coordination problem.
ANNEXES

Annex 1: Criteria for Choosing Outcome Indicators

The outcome indicators suggested in this report are based on criteria outlined in European Commission (2010) report. According to that report, indicators should be:

a. **Reasonable**: capturing the essence of an outcome according to a reasonable argument about which features of the outcome the indicators can and cannot represent.

b. **Normative**: having a clear and accepted normative interpretation (i.e., there must be agreement that a movement in a particular direction or within a certain range is a favorable or an unfavorable result).

c. **Robust**: reliable, statistically and analytically validated, and, as far as practicable, in compliance with internationally recognized standards and methodologies.

d. **Responsive to policy**: linked to policy as directly as possible and able to be affected by the policy actions they are used to assess, while not being subject to manipulation.

e. **Feasible**: built, as far as practicable, on available underlying data, and able to be measured without imposing too large a burden on the country, enterprises, or citizens.

f. **Debatable**: timely and openly available to a wide public, with room being built for public debate of the indicators for their own revision when needed.

Among these criteria, responsive to policy is particularly important. An indicator is of little value if it can be influenced by factors other than the policy results it is intended to measure.
### Annex 2: Potential Sources for the Data Used in M&E

<table>
<thead>
<tr>
<th>Methods</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of existing surveys or databases</td>
<td>Generally collected for purposes external to the evaluation and the measure (e.g. Community Innovation Survey data, opinion polls, business expenditure surveys, etc.).</td>
</tr>
<tr>
<td>Use of existing monitoring data collected during program lifetime</td>
<td>Use of data and other information relating to the program’s administration, activities or performance systematically collected during the program.</td>
</tr>
<tr>
<td>Participant surveys</td>
<td>Surveys conducted to the participants or beneficiaries of the program.</td>
</tr>
<tr>
<td>Non-participant surveys</td>
<td>Surveys conducted with those who have not directly participated in, or are not the main intended beneficiaries of, a program.</td>
</tr>
<tr>
<td>Participant interviews</td>
<td>Interviews conducted with those who have participated in a program (e.g. recipients of funding) or those who have benefited from the activities or services provided by a program.</td>
</tr>
<tr>
<td>Non-participant interviews</td>
<td>Interviews conducted with those who have not participated in a program (e.g. recipients of funding) or who have not benefited from the activities or services provided by the program.</td>
</tr>
<tr>
<td>Bibliometric or patent databases</td>
<td>Searches of scientific publications (and sometimes their citations) and patents from bibliometric and patent databases.</td>
</tr>
<tr>
<td>Focus groups, workshops, group meetings, etc.</td>
<td>A panel of people selected for their knowledge on a topic of interest, brought together to discuss the topic with the assistance of a facilitator.</td>
</tr>
<tr>
<td>Document and literature searches</td>
<td>Use of documents and literature related to a program. May include, administrative manuals, application forms, assessment forms, existing evaluation reports and broader policy reports.</td>
</tr>
</tbody>
</table>
Annex 3: Impact Evaluation in Practice

There are several ways to involve impact evaluation without disrupting a project. For example, if resources for matching grants are scarce, requiring that grants be allocated according to a certain rule, that rule can provide the basis for an impact evaluation. Perhaps the grant applications are screened and many are found to be very promising. Out of those, grants can be distributed on a randomized basis. Or perhaps the grant applications are ranked and only those above a certain threshold are funded. Then the evaluation can look at those that just barely met the threshold and compare their outcomes with the outcomes of those just below the threshold. The following subsections describe some common impact evaluation methods in more detail.

**Differences-in-Differences**

In a differences-in-differences design, changes in outcomes are compared for those that received the program sooner and those that received it later. The necessary assumption is that in the absence of the program, the group that received assistance sooner would develop in the same way as the group that received assistance later.

The figure below provides a graphical representation of the method. There are only two time periods in this simplified example: Period 1 and Period 2. One observes levels of the outcome variable in Period 1, pre-treatment; the treatment group then receives the treatment between Period 1 and Period 2; finally, one observes levels of the outcome variable again in Period 2. The picture on the far left provides a depiction of the observations. If one were to solely look at the changes in the outcome variable for the treatment group (denoted “A” in the middle picture), one would miss the fact that the outcome variable also changed for the control group (denoted “B”). If one assumes that the only difference between the changes undergone in the treatment group and the changes undergone in the control group was due to the treatment, the actual impact of the intervention is A-B, or “C” in the diagram on the far right.

**Figure 6.8: Graphical representation of differences-in-differences**

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Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme “Development of the Competitiveness of the Bulgarian Economy” 2007-2013”, financed under Priority Axis 5 “Technical Assistance” of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
The timeline of a differences-in-differences approach is illustrated below. In this program, the treatment is rolled out in four waves, with thirty treated in each wave. This staggering of treatments allows for a comparison of those that have and have not received the program at the same point in time. For example, one could compare the outcomes of treatment group T1 with the outcomes of groups T3 and C in Period 2. Depending on how rapidly one expects to see an effect, one could also use data on T2 in Period 2.

Figure 6.9: Graphical representation of timing of roll-out

One potential drawback of differences-in-differences is that it relies on the assumption that different groups would have similar trajectories independent of the program. If the groups that have not received treatment alter their behaviour in anticipation of the treatment, this could be problematic. Further, the timing of the roll-out needs to be such that the effects of the program can be observed before the roll-out is complete. In the above example, if the program were to take four periods before having any effect, the effects of the program would not be evident and the different treatment groups might look equivalent over this duration.

**Randomized Experiment**

A randomized experiment is the same in principle as a differences-in-differences approach, except that the subjects are randomized into the treatment and control groups rather than being assigned to those groups based on other selection criteria. There are generally only two periods of time in which treatment will be given, and what is randomized is who will receive treatment first.

By randomizing who is assigned to the treatment group and who is assigned to the control group, one ensures that any difference in changes to the outcome variables can be attributed solely to the program. Without randomization, it is possible that the factors that affected selection into the treatment group (for example, proximity to a major urban area) also affect the change in the outcome variable over time. In
other words, with a differences-in-differences approach, it is more likely that even without the intervention, the treatment group and the control group would exhibit different trends.

Randomization is regarded as the gold standard in impact evaluation, as it avoids selection bias and can show the mean impact of a program. It also has the advantage of being perceived as a fair way of allocating access to the program when resources are limited.

A disadvantage of randomization, however, is that there may be ethical issues or political constraints that make it infeasible. There is also the problem of whether a randomized controlled trial, which has the best internal validity, has external validity; in other words, whether the results of a particular study are generalizable to different contexts. Finally, one has to be careful that the randomization does not create an “expectations” effect on the control group, if, for example, they anticipate receiving the program shortly. This last disadvantage is shared by differences-in-differences, regression discontinuity experiments when there is a possibility the program may be extended to cover more participants, and in general by any program in which roll-out is phased over time or expectations of the control group are changed.

**Regression Discontinuity**

Most programs target a particular group. In a regression discontinuity design, the rule might be that people have to be below a set poverty line to receive the program.

The regression discontinuity design looks at the differences in outcomes between those just above and those just below that cut-off line. The idea is that these people are otherwise very similar in characteristics, so any difference in outcomes must be due to the program itself.

This method estimates the effects of the program only on those closest to the threshold. This could be an advantage or a disadvantage. For example, if one were considering expanding the program to cover those a little above the poverty line, this method could help determine what the effect would be of expanding the program to that target group. However, if one were interested in estimating the overall effect of the program on an average recipient, this method would not be ideal. Further, in order for this method to be useful, the threshold has to be strictly applied, and subjects should not be able to manipulate whatever score is used to make them eligible. There also needs to be a sufficient and equivalent number of subjects just on either side of the threshold.

**Instrumental Variables**

Instrumental variables have few applications in modern impact evaluation. This method relies on identifying a variable – an instrument – which is correlated with the program but not correlated with the outcome variable of interest except through the program. For example, in some agricultural societies, rainfall might be strongly associated with level of income. If one is interested in the effects of income shocks on various outcome variables, one could therefore use rainfall as a proxy for income. This would
be useful if the concern is that the outcome variables could also cause changes in income, because in that situation, the effect of income on the outcome variables could not be determined directly.

The data requirements of this method are very high, and it is usually difficult to identify an instrument that is strongly correlated with the independent variable. Since results will not be robust with a weak instrument, this method has relatively low credibility and should only be used in a few rare circumstances.

**Matching**

Matching, too, should be used only rarely. In this method, program participants are matched with non-participants from a larger group based on their characteristics. The idea is to come up with a counterfactual group that is identical in all relevant respects to the group that received treatment. This method relies on the assumption that, conditional on the set of observables, there is no unobserved characteristic which is different between the two groups and is driving results.

There are many ways of carrying out the matching in practice. One can use nearest-neighbour matching (pairing each individual to the individual whose characteristics provide the closest match), one can match a participant to multiple non-participants, and so on. One can choose to assign different weights to the different characteristics being matched. When the set of observed characteristics used to match participants and non-participants is large, a summary statistic is often used as a basis for the matching: the propensity score, or the probability of participation as a function of the observables.

Still, matching should be used only if no other tools are available, because it requires very strong assumptions about which individuals could be considered comparable before treatment. It is often carried out after the program has ended, which can mean that no data were collected before the program on some of the characteristics likely to be relevant to the outcome. Bias also often accidentally seeps in at this stage, as researchers may inadvertently select matches that bolster their initial beliefs about whether the program was effective.

The data requirements of this method are very high. Further, if a program is being rolled out over time and can take advantage of a differences-in-differences technique or a randomized approach, at the end of the day the only people surveyed are those who received the program. Because matching, by contrast, requires data on people who did and did not receive the program, it could potentially impose much higher surveying costs.

Overall, the matching method is not reliable, and should be used only to estimate some effects after a program has been completed, if the program did not plan for an impact evaluation before it began.
Chapter 7.  Towards Smart Specialization in Industry: Sector Analysis

A.  Introduction

7.1.  Improving the business environment and strengthening the country’s skills and technological capabilities would encourage Bulgarian firms to develop new products and invest in efficient production processes, increasing the share of high value-added products and services in total exports and improving the country’s competitiveness. Knowledge creation and innovation are driven by market competition and entrepreneurship; however, where market forces are unlikely to produce the desired outcomes, they can be induced by carefully targeted government support focusing on promoting competition and innovation intensity. Such support, including from EU funds, would unleash the innovation potential of Bulgaria’s business and research communities and increase growth and competitiveness.

7.2.  As mentioned in Chapter 2, technology road-mapping can serve as a useful tool to address coordination failure among stakeholders and develop common innovation goals. Technology mapping paves the way for the development of clusters, which then support innovation and technology diffusion. Experience in industrialized countries has shown that cooperation among innovative SMEs can translate into productivity gains and growth opportunities. Clusters create markets for workers with specialized skills, increase information flows and knowledge diffusion, and foster trust between contractual parties, which promotes further cooperation and specialization. Initiatives aimed at clusters rather than individual firms also lower transaction costs, facilitate learning, and promote investment in both physical capital and intangibles. Such initiatives might involve strengthening clusters’ demand for technological services and improving the work of intermediaries, linking SMEs with international firms within industrial parks, and enhancing cooperative links through brokering and related programs.

7.3.  Extensive consultations during the preparation of this report revealed the willingness of the private sector and academia to engage in such an interactive process. This interest should be leveraged during consultations on the Smart Specialization Strategy. Experience has shown that combining top-down with bottom-up road-mapping approaches works best.

7.4.  This chapter initiates the technology roadmapping process by providing a snapshot review of sectors with the potential to have a significant impact on the overall competitiveness of the Bulgarian economy and foster innovation-driven growth. It assesses constraints to development in the five priority sectors identified jointly with MEE – food processing, machine building and electronics (MBE), pharmaceuticals, information and communication technology (ICT) and creative and cultural industries. It then proposes specific policies and instruments to develop their innovative potential in line with the four “C”s of the Smart Specialization Strategy as outlined by the EC: i) competitive advantage, ii) connectivity and clusters, iii) collaborative leadership, and iv) choices and critical mass. In addition to being prioritized in Vision 2020, all five sectors are characterized by: (i) their high potential to contribute
to growth, exports, value added, and employment; (ii) a favorable regional context; and (iii) their high potential for collaborative R&D and innovation intensity.

B. Sectoral Case Studies

7.5. The promotion of scientific research and business innovation will contribute to the transformation of the Bulgarian economy, by raising technological capabilities and improving the quality of the products manufactured and services offered on domestic and international markets. The sectoral case studies\(^{107}\) focus on five key sectors for development in Bulgaria given their potential for growth and importance for the economy\(^{108}\.\) food industry, pharmaceutical industry, mechatronics, machine-building and electronics, information and communication technologies, and cultural and creative industries.

7.6. Each sector snapshot is based on a review of international and national reports; inputs from focus groups and workshops; and bilateral meetings with key industry leaders and stakeholders. The results for each sector are organized as follows:

a) Key sector characteristics and recent developments, including competition dynamics in some subsectors;
b) Key challenges and obstacles to sector development and growth;
c) Regional development and specialization– identification of specialized regions in Bulgaria, based on employment and value creation;
d) Sector ecosystem– assessment of R&D, education, skills, and technological innovation in the sector, and gaps between existing levels and what is required;
e) Sector opportunities and scenarios – identification of potential scenarios and directions for sector development;
f) SWOT analysis – description of the sector’s main strengths and weaknesses, its potential to increase national innovative capacity, and threats that may affect its innovation potential.

7.7. This snapshot review uncovered constraints to innovation-driven growth that are sector specific, but also constraints that are common for all sectors.

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\(^{107}\)See Report of the World Bank on Smart Specialization Strategy (February 2013)

\(^{108}\)Case studies based on extensive consultations with business representatives and theoretical studies explore the strengths and weaknesses of the five sectors, examine the trends and analyze the potential generated by the current economic policies.
Table 7.1: Sector Overview

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Food Processing</th>
<th>Machinery Building and Electronics</th>
<th>Pharmaceutical</th>
<th>Information and Communication Technology (ICT)</th>
<th>Creative and Cultural Industries (CCI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Proposed S3 Business Innovation Instruments</strong></td>
<td>Technology Road-mapping</td>
<td>Technology Road-mapping</td>
<td>Technology Road-mapping</td>
<td>Business Incubators with Early Stage Financing</td>
<td>Business Incubators with Early Stage Financing</td>
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<td></td>
<td>Certification Laboratories and Experimental Fields/Food Processing Facilities</td>
<td>Technology Upgrading and Diffusion</td>
<td>Technology Extension Programs</td>
<td>Seed/Accelerator and VC Funding</td>
<td>CCI-tailored Matching Grants for Developing/Integrating Innovative Products, Processes, Marketing, and Organizational designs.</td>
</tr>
<tr>
<td></td>
<td>Competitive Matching Grants to for Business-Research Collaboration Integrating Clusters and Innovation Networks (proposed Agro Tech Park in Plovdiv)</td>
<td>Replicating Successful Clusters and Innovation Networks (Electro mobiles, Hydraulics, LED Technology)</td>
<td>Competitive Matching Grants to for Business-Research Collaboration</td>
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<td></td>
<td><strong>Proof of Concept Labs</strong></td>
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<td>Technology Transfer Office consortium</td>
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<td></td>
<td>Focal point for innovation ecosystem through flagship innovation platforms: sector-specific Tech Parks (Sofia Tech Park, Plovdiv Agro Tech Park), clusters and innovation networks</td>
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<td></td>
<td><strong>Government Coordination – National and regional level (which ministries)</strong></td>
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<td></td>
<td>Ministry of Agriculture and Food</td>
<td>Ministry of Labor and Social Policy</td>
<td>Ministry of Health</td>
<td>Ministry of Health</td>
<td>Ministry of Health</td>
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<tr>
<td></td>
<td>Ministry of Environment and Waters</td>
<td>Ministry of Labor and Social Policy</td>
<td>Ministry of Labor and Social Policy</td>
<td>Ministry of Labor and Social Policy</td>
<td>Ministry of Labor and Social Policy</td>
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<td>Ministry of Labor and Social Policy</td>
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<td></td>
<td><strong>Integrated approach and alignment of policies on education and vocational training; scientific research and human capital formation; collaboration between business and research, technology upgrading and diffusion, promoting business-lead R&amp;D; improving protection and enforcement of intellectual property rights and commercialization of research and innovations</strong></td>
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<td></td>
<td>National-level coordination body with regional branches</td>
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<td></td>
<td>Single governance body and speedier delivery of research and innovation support instruments.</td>
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<td></td>
<td><strong>Regional Specialization (how these industries are performing in each region)</strong></td>
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<tr>
<td></td>
<td>Varying degree of clustering, and regional distribution with highest concentration in the South West and South Central Regions (Sofia, Blagoevgrad, Silven, Plovdiv, Stara Zagora)</td>
<td>Higher level of clustering with highest concentration in the North East, South East, North Central and South Central Regions (Varna, Shumen, Razgrad, Troyan)</td>
<td>Higher level of clustering with highest concentration in the South West, North Central and North East Regions (Sofia, Dupnitsa, Razgrad, Troyan)</td>
<td>Very high level of clustering concentrated in Sofia (over 85%) and some concentration in Plovdiv, Varna Ruse.</td>
<td>Very high level of clustering concentrated in Sofia and clusters in Plovdiv, Stara Zagora, Burgas and Ruse.</td>
</tr>
</tbody>
</table>

Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013", financed under Priority Axis 5 “Technical Assistance” of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
Table 7.2: Constraints to Innovation

<table>
<thead>
<tr>
<th>Sector</th>
<th>Sector-specific constraints to innovation</th>
<th>Cross-cutting constraints to innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food processing</td>
<td>- Lack of technological and equipment upgrading &lt;br&gt;- Insufficient supply chain</td>
<td>- Shortage of skilled labour &lt;br&gt;- Lack of collaboration between the business, university and research communities &lt;br&gt;- Energy inefficiency overcoming traditional costs advantages such as low labour costs, relatively low tax burden and proximity to markets in the Middle East and the Former Soviet Union</td>
</tr>
<tr>
<td>Mechatronics</td>
<td>- Large number of small players at lower end of the value chain</td>
<td></td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>- Lack of transparent regulation and procedures for early stage clinical trials</td>
<td></td>
</tr>
<tr>
<td>ICT</td>
<td>- Inadequate system for protection for ICT related assets such as service innovation and business process innovation</td>
<td></td>
</tr>
<tr>
<td>Creative and cultural industries</td>
<td>- Inadequate system for protection for IP assets such as service innovation and business process innovation &lt;br&gt;- Shortage of creative talent and persons with creative entrepreneurial skills &lt;br&gt;- Very poor awareness of EU funding opportunities and limited skill and capacities how to access these &lt;br&gt;- Poor collaboration between researchers and CCI businesses in content development</td>
<td>- Poor enforcement of IPR rules &lt;br&gt;- Severely constrained access to finance</td>
</tr>
</tbody>
</table>

7.8. The following section provides more details about each of these sectors.

C. Food processing sector

- General characteristics of the sector:
  - Regionally distributed with varying degrees of clustering
  - High innovation intensity
  - Low R&D intensity
Key sector characteristics and recent developments

7.9. 2011 EU sector development snapshot (Eurostat data):

- Turnover: EUR 956.2 billion (largest manufacturing sector in the EU (16 percent of total GDP);
- Employment: 4.1 million people (largest sector in EU in terms of employment (16 percent of manufacturing sector);
- SMEs: 48.7 percent of food and beverage turnover and 63 percent of food and beverage employment;
- Number of companies: 274,000 (13.4 percent of manufacturing firms);
- Value added (percentage of EU GDP): 2 percent (13 percent of manufacturing sector);
- EU market share in global export: 17.8 percent (down from 20.4 percent in 2000);
- R&D (percentage of food and drink output): 0.38 percent;
- Labor productivity in the manufacturing industry: food products EUR 38,000 per employee, beverages EUR 70,000 per employee;
- Labor productivity increases with the size of company (SME labor productivity = EUR 33,000; large companies = EUR 60,000);
- Large companies have higher value added and turnover, but lower total number of employees than SMEs;
- The meat sector is the largest sub-segment, representing 20 percent of total turnover;
- The bread and bakery sub-segment ranks first in terms of value added, employment, and number of companies;
- The EU accounted for 42 percent of all agri-food patent applications submitted worldwide in the period 1998-2008;
- Estonia has the highest share of product innovation in the food industry, followed by Finland and Germany. In most EU member states, process innovation is surpassed by product innovation;
- Out of the top 1,000 companies investing in R&D in all the sectors of the EU economy in 2010, 37 food and beverage companies invested a total of EUR 2.3 billion, corresponding to 2.2 percent of total investment.
7.10. The food processing sector in Bulgaria remained relatively stable in the wake of the recent financial crisis. The sector has good innovation potential, both in business processes and products and in services. The positive trend of growing consumer demand for food products in the higher value-added market segment will draw the sector in the direction of producing innovation-based higher-quality and specialty foods. Foreign retailers have a significant market presence, with domestic retailers holding only about 30 percent of the market.

Table 7.4: Top 20 Growing Companies in the Food Processing Sector (2010-2011)

<table>
<thead>
<tr>
<th>Company and location</th>
<th>Income growth 2011/2010 (in %)</th>
<th>Income 2011 (000, BGN)</th>
<th>Income 2010 (000, BGN)</th>
<th>Net profit 2011 (000, BGN)</th>
<th>Number of employees 2011</th>
<th>Number of employees 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MesniProdukti “Zhar” (Varna)</td>
<td>7,739.34</td>
<td>4,782</td>
<td>47</td>
<td>101</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2 Nordiks (Trud)</td>
<td>1,866.93</td>
<td>12,667</td>
<td>128</td>
<td>16</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>3 Mandra “Riltsi” (Sofia)</td>
<td>272.64</td>
<td>16,016</td>
<td>572</td>
<td>132</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>4 Boomerang 2009 (Sofia)</td>
<td>269.70</td>
<td>4,466</td>
<td>683</td>
<td>30</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>5 Trakia 2006 (Plovdiv)</td>
<td>259.18</td>
<td>34,438</td>
<td>1,693</td>
<td>208</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>6 Bulmes Group (Sofia)</td>
<td>256.62</td>
<td>5,310</td>
<td>131</td>
<td>57</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>7 Kris-Oil-97 (Kaspichan)</td>
<td>172.20</td>
<td>6,236</td>
<td>132</td>
<td>40</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>8 Bulmalt (Sofia)</td>
<td>142.45</td>
<td>13,257</td>
<td>272</td>
<td>49</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>9 Merkez (GoseteDelchev)</td>
<td>135.52</td>
<td>29,141</td>
<td>2,491</td>
<td>76</td>
<td>361</td>
<td></td>
</tr>
<tr>
<td>10 Fishcom (Sliven)</td>
<td>129.45</td>
<td>12,373</td>
<td>1,976</td>
<td>1,041</td>
<td>165</td>
<td>45</td>
</tr>
<tr>
<td>11 Eco Furazh (Varna)</td>
<td>120.11</td>
<td>5,003</td>
<td>1,618</td>
<td>61</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>12 Pleven-Mes (Pleven)</td>
<td>118.01</td>
<td>4,201</td>
<td>202</td>
<td>40</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>13 Exotic 2000 (Stara Zagora)</td>
<td>117.55</td>
<td>11,815</td>
<td>3,070</td>
<td>54</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>14 SiCo (Pleven)</td>
<td>103.19</td>
<td>4,017</td>
<td>58</td>
<td>39</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author’s calculations.
7.11. The sector depends on the import of raw materials, machinery, equipment, know-how, and other inputs and supplies: all sub-segments of the food processing are dominated by imports, with the greatest share in meat, poultry, fruits and vegetables, and organic products.

7.12. Modern technologies, equipment, and innovation-based resource-saving (energy and water) manufacturing processes are needed to improve the competitiveness of local businesses. The absorption of EU funds aimed at financing technological upgrading is paramount, as upgrading is often a precondition for meeting EU product quality and safety standards and for developing innovative products and processes that help companies enter higher value-added markets.

### Source:
Box 7.1: Setting the Stage for Innovative Products and Processes – Bulkarto

History and Development

Bulkarto is a food processing company based in Gabrovo with significant presence in Sofia – own storage and logistics center, and an extensive supply and distribution network through Bulgaria. It started operations in 1992 as an importer, wholesaler and distributor of prefabricated and frozen foods, bakery goods and confectionary for restaurants and retail outlets. It operates in close partnership with Belgian food producers and processors of frozen foods. Over the past few years Bulkarto is focusing its operation on the market segment for blanched potatoes.

The company started in 1992 with eight employees, 20 years later it employs over 50 people. Over the years of operation all employees have benefited from extensive skill upgrading trainings, including specialized trainings on introducing Hazard Analysis and Critical Control (HACCP) in industrial food processing facilities. Bulkarto is certified under ISO 22000 and holds IFS Logistics Certification; all of its employees are certified in their field of narrow specialization.

With time the turnovers of the company have grown steadily: 2001 being the tipping-point for the company’s growth with a turnover close to BGN1.5 million, growing to a little under BGN6 million in 2006, which the company doubled in 2011.

Key Products, Markets and Buyers

Bulkarto’s key products are prefabricated and frozen foods, with a significant specialization in the blanched potatoes market niche where the company holds approximately a 25 percent share of the national market. Its products and services are geared predominantly to wholesalers, about 70 percent of the company’s output; the remaining 30 percent of Bulkarto’s customer base are restaurants and retail outlets.

The company’s development over the years has been based on a clear vision for continuously flexible product offering. The company leverages innovative marketing and sales techniques allowing it to be more flexible with respect to product composition, distribution, and delivery and pricing practices. A process innovation spearheaded by the company in its early stages of development include novel marketing techniques to introduce prefabricated frozen bakery and confectionary products in Bulgarian wholesale and retail chains. Current innovation efforts are devoted to using flexible techniques of delivering and maintaining product inventories, specifically in the frozen foods and blanched potatoes market segment.

Based on existing innovative processes for flexible distribution and delivery of product inventories Bulkarto is planning the development of the next stage of innovation through which the company could expanding its operations to neighboring countries in the region and countries in the former Soviet Union. The backbone of the planned innovation, effectively enabling the company to enter the higher-value-added segment, is technological upgrading using the latest packaging and logistics solutions. Over the past year, the company has made over BGN200 thousand in technology and skills upgrading investments. The program was jointly implemented with partners from Belgium. Next steps include technology customization, training of the personnel, developing marketing and sales strategies.

Government and Business Associations Support and Awards

Bulkarto is not a member of any business association and has not benefited from any funding opportunities offered through national instruments to promote innovation and competitiveness. Despite that, the company enjoys good visibility on the market: it was awarded a Gold Medal at the International Trade Fair in Plovdiv in 2008 and it hosted a visit of Bulgarian government officials and the Belgian Ambassador in 2009 as its production facilities were cited as good-practice of commercial partnership between Bulgarian and Belgian companies.

Investment in technological upgrading enables the company to devote its future efforts to enter the higher value-added market segment through product and process innovation. The upgrading will allow Bulkarto to gain greater...
7.13. Most of Bulgaria’s arable land is devoted to the production of grains, corn, and vegetable oil plants and only an insignificant portion of the land is devoted to the production of fruits and vegetables, which enforces a heavy dependence of fruit and vegetable processors on imported raw and pre-processed materials.

- Processors. Bulgaria has a long tradition of fruit and vegetable processing. Most factories are local investments, while just a few are owned by international companies. Approximately 50 percent of local production is export oriented. The segment offers opportunities for technology and equipment upgrading; know-how transfer; and research and innovation in new products, processes, and production inputs.

- Imports exceed exports in the sector due to the lack of raw materials. Imports account for approximately 55 percent of the market, while most locally owned processing companies export more than 50 percent of their production. Major export destinations are Germany, Romania, Greece, and the United States.

- The local processing segment, predominately canned foods, is geographically fragmented all over the country, but with a heavy concentration of producers in the Plovdiv and Stara Zagora regions.

- Workforce. Because of rural depopulation over the past 60 years, Bulgaria’s workforce is situated mostly in urban areas. The rural-to-urban migration began with accelerated industrialization in the 1950s–1970s and has been steadily dropping: from 75.3 percent in 1946 to 35.2 percent in 1985 and to 29.3 percent in 2007. This has been a result of multiple interconnected factors, including falling birth rates, declining rural population and slow rural economic development. While this trend has had some impact on food processors, it has had a devastating effect on agricultural production.

- Importers/wholesalers. Bulgaria is a net importer of fruits and vegetables, including through large retail chains. Citrus fruits and bananas hold the largest share of fruit imports, but tomatoes, onions, peppers, potatoes, and other vegetables that could be locally produced are also imported. Most local production has ceased in the past decade. To a large extent, this is a result of misguided policies, the depopulation of rural areas, inefficient distribution chains, and unfair competition from illegally imported fruit and vegetables.

- Distributors. The relationships among importers/wholesalers, retail chains, and traders are complex, and there are no clearly dominant or obvious trade channels for reaching end consumers. Instead, products are distributed through a wide variety of smaller and not well-coordinated channels. Large retailers usually buy directly from importers or producers; however, as chain retailing gains ground, distribution by major players (either growers or traders) is

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Key challenges in the food processing sector

7.14. In addition to being a net importer of fruits and vegetables, Bulgaria also imports a large amount of food processing machinery and equipment. Local manufacture accounts for about 23 percent of the machinery and equipment market, and focuses on packaging, filling and closing, milk processing, bakery, meat processing, and canning and bottling.

7.15. Two major impediments to growth in the sector are the lack of resource-saving and cost-effective technologies and equipment, and the lack of workers experienced in technology and engineering for innovation. In addition, facilities are outdated, clusters and sector structures are still underdeveloped, and the supply chain is inefficient and poorly integrated. Further, there is a low level of R&D and innovation intensity, ecosystem integration, and collaboration between businesses and food and plant research institutions. Funding for research is still very limited, and available financial resources, especially EU funds, are not used effectively. An example of the organization with unique business model DNA that was able to overcome similar challenges in the Food Sector, is presented in Box 7.2: Fundacion Chile: Transformation of the Food Industry in Chile and its relevance for Bulgaria.

Box 7.2: Fundacion Chile: Transformation of the Food Industry in Chile and its relevance for Bulgaria

Country Background in Food Industry: Chile is the only Latin American Country that had a period of at least 14 years of rapid TFP and GDP growth: 2.6% of TFP and 7.1% of GDP in 1984-1997. High productivity growth was due to structural change, shifting resources from import substituting sectors to export-led natural resources based sectors, with significant FDI and capital accumulation and Technology Transfer and adaptation (Self Discovery). Chile has emerged as a world power in high quality food Exports: From US$1billion in 1986 to US$ 20 billion in 2012, accounting to 11% annual growth in 28 years. Most of the increase in productivity happened through the entry of new firms to new sectors.

Fundación Chile (FCH) played a major role in country’s shift toward higher value added industries and economic growth. It contributed to development of several sectors, including food sector development, which is the focus of this case study. Fundacion Chile is a non-profit public-private institution with a unique organizational DNA, founded in 1976 through a partnership between the Chilean government and the ITT Corporation, and BHP Billiton joined as a co-founder in 2005. Fundacion Chile’s mission is to add economic value to Chile’s products and services by promoting innovation and technology

110Funding targeted for all research, through the National Science Fund, is approximately BGN 7 million per year an insignificant portion to food research.
transfer activities, aimed at taking better advantage of Chile’s natural resources and human capital. Fundacion Chile is known as one of the most prominent organizations that foster the innovative business/industry development and technology/knowledge transfer in Latin America. It supports the development of business clusters and industrial niches, including the famous salmon and wine industry. Fundacion Chile carries out a collaborative research with other participants in the innovation system, including multinationals, domestic firms and research agencies (Fundacion’s open innovation model is exhibited on the diagram(1) above).

**Business Model:** Fundacion’s model is unique because it involves the entire process of innovation from identifying the idea through to marketplace implementation. It has a market-centered approach for technology selection and the creation of innovative companies and divesting from them as an exit and diffusion strategy. Fundación Chile’s business model largely operates through the following instruments: (i) Technology Transfer and Dissemination, (ii) Seed Capital and Research Grants, (iii) Collaborative research, (iii) Knowledge Exchange programs and services in management consulting, financial planning, and strategic advice.

**Fresh Fruit and Agrifood Sector** in Chile accounts to 50% of the off-season export to the north hemisphere. The Fundación has contributed to diversifying exports from the 1st to the 10th region, by incorporating citric fruits, olive oil, goat cheese, new varieties of berries, apples and others. It also develop the first quality certification company, which play a key role in supporting exports of fresh and process fruit. Today it is also working on high-value vegetable preserves, making the most of government investment in irrigation dams. The knowledge base reveals that there are opportunities to continue diversifying the agro-industrial supply and adding value to current production. Other public programs were highly beneficial: collaboration with PROCHILE Export Promotion, government legislation for fruit varieties protection that promoted import of new varieties, public investment in Transport infrastructure and major irrigation projects 90’s, INIA and universities research on diseases and agronomic practices, and support of associations to become involved in R&D consortia.

**Wine:** Chile is forecasted to become a number one wine exporting country of the southern hemisphere in 2013-2014, where the wine-making is a traditional activity that goes back to colonial times. Until 1980’s Chilean wine was not accepted in the developed markets, because it contained heavy, oxidized and high alcohol content. However, a process of technology diffusion led to the rapid growth of the new wine industry where traditional production was changed to new technology and export orientation. Miguel Torres Spaniard winemaker started exports of new wines in 1981 from Chile using its commercialization channels. The government and winemaker business associations played a key role in the rapid expansion of the exports. Fundación Chile play a role expanding the wine frontier to the south, but most important organizing technology international missions with old fashion wine makers to obtain the know- how of the wines of the new world. Also it organized “Corporacion del Vino” an association of small size winemakers that jointly undertook agronomic and technological research and the development of club goods.

**Salmon industry:** Fundación Chile invented the industry in the southern hemisphere shifting government effort in developing ocean ranching to aquaculture-based industry taking into account the recent developments in salmon aquaculture in the late 1970’s. It demonstrated a high prospective capacity of global technology and market trends relevant to Chile. Fundación Chile started the first companies in the early 80’s: in 1981 it acquired Domesa Farms, in 1982 Salmones Antarctica was created (eventually sold to Japan’s Nippon Suisan Kaisha) and during 1985 – 1987 Fundación Chile has successfully established a new industrial cluster by creating new companies: Salmones Huillinco S.A.(smolt production), Salmotec S.A.(expansion to the south) and Finamar S.A.(value added). In 1986 the salmon export was only US$6 million and in 2007 it reached US$ 2.5 billion (30% of the world export market). Salmon industry in Chile grew in a period of two decades from zero to a world-class export-oriented dynamic sector mainly through a technology transfer and imitation of a proven non-proprietary technology for salmon. Success was also drawn from a previous investment in know-how and human capital, and the existence of strong latent comparative advantages. However, in 2009 the Atlantic salmon aquaculture industry in Chile experienced significant quality issues due to the ISA infection (the same disease that harmed the Scottish salmon industry), despite the effort of Fundación Chile of developing technology and environmental certification schemes to prevent.

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coordination failures that jeopardized sector development.

To overcome Bulgaria’s challenges, determinants\(^2\) of Fundacion Chile’s success can be an option:
1. Non-profit private institution and free of political interference
2. Strong market orientation
3. Emphasis in technology management and especially, its transfer and dissemination
4. High financing discipline reflected in its self-financing components
5. Reliability and trust with a strong public-private sector cooperation and R&D collaborative research
6. Efficient network management and global alliances
7. Creator of innovative sectors and companies


Regional development and specialization

7.16. The various regions in Bulgaria have a high level of specialization in basic agricultural production, but very limited specialization in high value-added processing and innovation-intensive activities. The majority of companies that produce both basic and value-added products are based in the southern half of the country.

Table 7.5: Bulgaria Food Sector Snapshot

<table>
<thead>
<tr>
<th></th>
<th>North West Region</th>
<th>North Central Region</th>
<th>North East Region</th>
<th>South Central Region</th>
<th>South East Region</th>
<th>South West Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment</td>
<td>7,202 (8.9% of the workforce)</td>
<td>11,383 (14.1% of the workforce)</td>
<td>10,229 (12.7% of the workforce)</td>
<td>16,649 people (20.7% of the workforce)</td>
<td>11,360 (14.1% of the workforce)</td>
<td>23,724 (29.5% of the workforce)</td>
</tr>
<tr>
<td>Number of firms</td>
<td>483 firms (11.0 percent of total)</td>
<td>589 firms (13.5 percent of total)</td>
<td>549 firms (12.5 percent of total)</td>
<td>969 firms (22.1 percent of total)</td>
<td>695 firms (15.9 percent of total)</td>
<td>1091 firms (24.9 percent of total)</td>
</tr>
</tbody>
</table>


7.17. The dairy segment has attracted significant foreign investment in the production of sterilized, pasteurized, powdered, and concentrated milk, as well as cream, cheeses, butter, milk oils, milk drinks, yogurts, milk-based desserts, and curds. Investment has led to significant technology transfer and dissemination, and the segment is one of the sector leaders of innovation-based products with good export potential.

7.18. Meat processing is the most dynamic segment in terms of developing innovation-based food products and services – a result of significant investments in new technologies and modern production and packaging in slaughterhouses and sausage production lines and implement EU product quality and
safety standards. The decline of domestic consumption has been successfully compensated by increased exports to other EU member states, Russia and the CIS, and markets in the Middle East.

7.19. The leaders in the beverage segment are cola-style soft drinks, followed by fruit-flavored carbonated soft drinks and lemonades. Consumption of cola drinks has been declining in favor of fruit drinks. Domestic juice production is growing, and exports to other EU member states, Russia/CIS, and Middle East markets are increasing. This segment is also the most dynamic in terms of innovative packaging, marketing, and distribution processes. The innovation trend is extending into modern production halls, bottling lines, PET bottle production lines, cooling and carbonating utilities, and production of juice concentrates.

7.20. The bread and bakery segment has developed a significant share of innovative products, resulting in much improvement in quality and assortment. Bulgarian bakeries are investing in modern equipment, and major areas of innovation are specialty and health food breads and flours, as well as technology upgrading of bakery equipment and automated bakeries.

7.21. The processed fruits and vegetables segment is divided into: (a) canned and pasteurized fruits and vegetables, and (b) dehydrated and frozen fruits and vegetables. Bulgaria has more than 150 canning factories, 65 of which produce 85 percent of the country’s final canned foods output. This sub-segment is heavily dependent on imported raw materials. The increase in dehydrated and frozen fruits and vegetable production is dependent both on increasing the supply of locally grown fruits and vegetables, and on the introduction of modern technologies and innovative processes for field-based production.

7.22. Honey processing has been increasing by about 3 percent a year since 2000, and exports have increased by about 26 percent, as a result of both domestic and foreign investments in honey processing and related laboratory equipment.

Wine

7.23. This segment is developing rapidly, particularly for low to moderately priced wines. Eighty percent of wine production is exported.

Organic foods

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111 Large investors such as Coca Cola and PepsiCo are increasing production of fruit flavored carbonated soft drinks.
112 There are eight Bulgarian juice producers, which have 93 percent of the market share.
113 The biggest importer of Bulgarian wine is Russia (49.2 percent of the total export). There is an increase in the export to Romania (223.4 percent), the Czech Republic (107.6 percent and Mongolia (101.7 percent while a decrease is reported in the export to Poland, Great Britain, Belgium, Germany, Latvia and Lithuania. The local market for the first half of 2011 was 41.5 million liters.
7.24. Bulgaria’s main organic products include fruits, breads, dairy products, honey, jams and preserves, as well as medicinal and aromatic plants such as lavender and rose oil. About 95 percent of local organic production is exported, mainly to other EU countries.

7.25. The production of certified organic foods is increasing; organic products include cereals, soy beans, oatmeal, fruits (plums, cherries, peaches, raspberries, and strawberries), walnuts and other nuts, medicinal and aromatic plants, and honey.

7.26. Another trend is the development of certified organic livestock (sheep, goats, pigs, cattle), and the import of certified organic livestock for breeding.

**Sector ecosystem**

7.27. Bulgaria’s food industry has benefited from substantial foreign investment, particularly in the dairy, meat, sugar/confectionery, and breads/bakery segments. Recessionary and competitive pressures, coupled with the requirement to comply with EU manufacturing guidelines, are driving further industry consolidation and the growth of innovation-based products and services.

**Research and development**

7.28. Bulgaria has a strong tradition of food research, with a well-developed education system, and many research organizations and universities with international linkages. The country has highly qualified researchers, who enjoy a significant level of mobility (especially the younger ones), as well as increasing opportunities to participate in international programs in the food and health fields as a result of EU membership. However, there is an acute need to bridge the gap between research and the market; an example of one such initiative is detailed in Box 7.3: Linking Research and Market Needs – Proviti JSC

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**Box 7.3: Linking Research and Market Needs – Proviti JSC**

**History and Development**

Proviti ([www.proviti.bg](http://www.proviti.bg)) is a dynamic young company established in 2011 focusing on biotechnological research, product and process innovation in the area of nutrition and more specifically in nutraceuticals, functional foods, dietary and food supplements and foods that improve specific health conditions. The company facilitates technological transfer, licensing and marketing of the innovative product concepts, as well as the licensing of process know-how. The company’s young management team has a significant consulting and professional services background, while its research team has over 20 years of experience in research, innovation and development of advanced biotechnology products in the field of nutrition and nutraceuticals. Proviti is an example of a company that has found its place in the innovation ecosystem by offering expertise throughout the innovation cycle and technological transfer processes.

**Key Products, Markets and Buyers**

Proviti’s products and solutions are geared towards food processors, producers of pharmaceuticals and dietary and food supplements. The first two products that the company is about to launch are in the areas of functional foods and food and dietary supplements, developed based on proprietary probiotic biotechnological product formula with high-added value. The product is based on a unique proprietary strain of L.acidophilusProviti

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(registered with CCM under CCM8427), that among other probiotic benefits has been proven through in-vitro trials to reduce serum cholesterol in human organism. The formula effects are additionally enhanced by combining the probiotic strains (L.acidophilusProviti; L.d. bulgaricus; Streptococcus salivarius subsp. thermophilus) with a highly effective prebiotic component. The probiotic formula can be delivered in various product forms such as eatable and drinkable yoghurts, capsules and others. The product is marketed under the proprietary brand Veda Bulgarica.

The process from development to patent application has taken the company close to a year and associated cost are about half of the company’s total costs to date. Future product development is focused on cardiac health, intestinal health and obesity targeting blood pressure and cholesterol control, inflammation treatment and protein absorption.

**Government and Business Associations Support and Awards**

Proviti has been successful in harnessing funding for innovative companies provided under national instruments. Through “Development of innovations by start-up companies”, a half a million BGN project, Proviti developed a bacterial agent with immuno-stimulating and prophylactic anti-inflammatory effect in the digestive tract; under “Development of innovative start-up companies by support for commercialization of innovative products, processes and services,” with BGN861,000 budget financed by the National Innovation Fund, the company implemented a lyophilized symbiotic agent with probiotic strain Lactobacillus acidophilus Proviti. The company is harnessing additional BGN638,000 in funding to develop new biotechnology products with enhanced bioactivity and healthy potential derived from milk processing byproducts and is also benefiting from BGN33,000 provided under JEREMIE to micro and small enterprises to develop innovative products in the functional foods and food supplements area.

7.29. R&D investment in the food processing industry is equal to about one percent of overall revenues, making it low to medium R&D intensive. Two core areas for future innovation are higher value-added products following technology upgrading, and the introduction of new ICT-based processes for production, trade, and retail and consumer activities.114

7.30. Other areas of innovation include new packaging technologies (edible coatings, controlled or modified atmosphere packaging, intelligent packaging, clean room technologies); inspection systems

114 Apart from promoting efficiency by reducing administrative workloads, modern ICT tools are important for monitoring production, improving quality management and product traceability. For example, new generation sensors can monitor and control the production process, provide information for adjusting inputs; nano-sensors in food packaging can be used to indicate a product’s condition in terms of temperature, storage life, etc.
using new sensing methods; and tracking and tracing systems to ensure product safety and guarantee product origin.

7.31. Because most facilities and equipment are outdated, there is a strong need for technologies that reduce product waste and processing and energy costs. There is also a need for integrated production and process design; flexible, decentralized, and miniaturized processing technologies to meet personalized demands; and hygienic and minimal processing systems for optimal quality and cleanliness. Solutions to these concerns exist, but are largely unexplored (see Box 7.4).
Box 7.4: The Synergy Process Solution – National Association for Technology Transfer

History and Development

The National Association for Technology Transfer (NATT) (www.natt.hit.bg), formed in 2005, is an initiative that is based in Plovdiv with the objective of interlinking biotechnology, food processing, intelligent energy generation, biofuels production and tourism. NATT is heralding the support and expertise of broad membership base from the Plovdiv research community, local government and businesses. NATT is also working in close collaboration with the Regional Chamber of Wine-Makers “Trakia”, an organization with 40 members that includes the most prominent local winemakers, to form synergies between wine-making and tourism, and the Consortium of High Quality Wine Producers “Trakia” created in 2011 to support the Regional Chamber in export promotion and marketing of high-quality wines produced in Plovdiv region.

Key Products, Markets and Buyers

NATT’s synergy process is a patented innovative solution converging advanced biotechnology, recycling and intelligent energy generation. The process interlinks various innovative and scientific processes. One of five innovative solutions developed by NATT is using corn, biomass and waste to produce bio-ethanol, while effectively and efficiently harnessing byproducts from production processes: residual heat, corn mash and dried seaweed to produce high-protein additives for animal feeds and improve the energy generation efficiency. The energy generation process is based on a patented solution using advanced bio-technology where part of the residual heat generated in biomass, waste recycling and ethanol production is reinserted in adjacent farms to covert CO2 into oxygen, which is reinserted in the energy generation process to improve its efficiency. Residual heat, basically free energy, can also be used food processing activities such as drying fruits and vegetables and heating greenhouses.

In collaboration with the Regional Chamber of Winemakers and “Trakia” Wine Consortium, NATT is also introducing synergies between tourism development and promotion of small wineries through an innovative tourism product.

Government and Business Associations Support and Awards

NATT has 23 patented inventions, as well as five pending patents, on creating synergies between production and marketing processes based on advanced scientific and innovative solutions in the areas of biotechnology, production of eco fuels, food processing and intelligent energy. As major partner of leading European scientific and research centers, NATT is also the beneficiary of EU financial support, including a direct grant to further develop the concept of synergy processes and focus on implementation.

In partnership with the Regional Chamber of Winemakers and “Trakia” Wine Consortium, NATT is also the beneficiary of four projects to form synergies between grape wine development, wine making and tourism, while the “Trakia” Consortium is the direct beneficiary of three EU programs to promote wines from the Plovdiv region at food exhibitions and trade fairs abroad, including recent presentations of Trakia wines in Moscow in September and in Hong Kong in November 2012.

Sector opportunities and scenarios

7.32. Bulgaria has all the conditions necessary for the production of quality innovation-based food products, which make the sector attractive to investors: strong traditions, excellent climate, and a competitively priced workforce that keeps operating costs low. Major factors that positively affect the sector include:

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- Ongoing upgrading of technological infrastructure; established capacities for the production of proteins, enzymes, vitamins, and spices.

- Ongoing innovation processes for new types of food products; introduction of new high-tech equipment, techniques, and technologies; introduction of EU quality standards for foods and beverages and their packaging; introduction of environmentally friendly production processes and packaging.

- The presence of well-established food research and food product development capacities.

7.33. The food processing sector is becoming more competitive despite a high proportion of outdated production equipment. However, structural problems in the food stuff production (farming) sector are still problematic. To fully utilize the food processing sector’s capacity, competitiveness in the farming sector will have to increase as well. Therefore, policies and support instruments should target both the food production and food processing sectors.

7.34. There are opportunities in the food processing sector for innovation in both business processes and manufacturing, to create total production chains through clusters that include companies in the primary sectors, processing, sales, and distribution. Cluster creation is apparent in the wine-making, dairy and organic products segments. An example of a bottom-up cluster initiative is the Plovdiv Agro Tech Center, which is a concept developed in the course of Feb-June 2013 meetings, instigated by local stakeholders that reached out to national government and local authorities (see Box 7.5)

**Box 7.5 : Plovdiv Agro-Tech Center in the Making**

The target group for the Plovdiv Agro-Tech Center are farmers, food producers, academic institutions and research institutes (e.g. Plovdiv University "Paisii Hilendarski", Agrarian University – Plovdiv, University of Food Technologies—"Plovdiv", Technical University of Sofia – Plovdiv Branch, Bulgarian Academy of Sciences, Bulgarian Agricultural Academy) that are active in the agri-food industry, as well as local authorities (District Governor and Municipality Council and the Mayor) and think tanks (e.g. National Association for Transfer of Technologies, Associations of grain producers, vegetable producers, clusters in the areas of bio-food production, wine-making, fruit and vegetable processors, among others).

At present, the linkage between local suppliers, producers and distributers in Bulgaria and global agri-food value chains is weak. It means that there are limited opportunities to benefit from export markets and constraining possibilities to upgrade to higher value added market niches. Therefore, there is a need for synergy efficiency among local key actors in the domestic value chain and the Agro-Tech Center initiative in Plovdiv responds to that need. The multimillion EUR initiative is preparing a proposal to apply for funding from OPIC 2014-2020, led by the National Association of Transfer of Technologies – Plovdiv and the Bulgarian Academy of Sciences, which gathered local and national stakeholders in several meetings between February-June 2013 to develop the concept.

The Plovdiv Agro-Tech Park would house a pool of instruments (e.g. Proof of Concept Centre, Food Safety and Certification Lab, Technology Transfer Office, etc.) that support promotion of industrial scale synergies in bio-tech, agro and food technologies; enhancing the competitiveness of local enterprise through the transfer, management and uptake of innovations; reinforcing the labor markets and specialized human resources through internships and job placements in agri-food business and high-level education programs corresponding to developed R&D and innovation priorities; and an overall continuous focus on developing improved agricultural /food production solutions.
The sector’s strengths, weaknesses, opportunities, and threats are summarized in Table 7.6.

Table 7.6: SWOT Analysis – Food Processing Sector

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong tradition in food research, highly qualified researchers, excellent research organizations and established partnerships with food and health research institutions abroad. High standards for food quality and safety and Well-developed transportation and distribution network Low labor costs Access to the EU Markets, tradition and presence in markets in Russia, CIS and the Middle East</td>
<td>Low level of R&amp;D and innovation intensity Weak collaboration between businesses in the sector, universities and research institutions Outdated facilities and technologies resulting in high energy and water consumption Inefficient supply chain due multiple intermediaries Limited exchange of information between research organizations and industry</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Access to EU market and traditions in markets in the Middle East and the CIS provide opportunities expansion and scale up - Increased demand for high-value added food products in both the export and domestic markets - Use of EU funds to invest technological upgrading, logistics centers and marketing</td>
<td>- Higher productivity in other EU Member States - Strong depopulation of rural areas resulting in labor shortage in rural areas where processors are located - Increasing constraints in access to financing due to EU financial crisis - Increasing raw material prices and equipment prices</td>
</tr>
</tbody>
</table>

D. Machinery building and electronics sector

**Key sector characteristics and recent developments**

- General characteristics of the sector:
- Regionally distributed with varying levels of clustering
- High innovation intensity
- Medium R&D intensity

7.35. 2011 EU sector development snapshot¹¹⁵:

- Electronics and electrical equipment sector in EU employs around 3.6million people and had an output of EUR50.8billion in 2007, representing 9.8 percent of the total EU manufacturing

industry.

- Value-added growth in the electronics sector outperforms the average growth of the EU economy. From 1995-2000, the yearly growth in the sector exceeded 9 percent, and almost 13 percent in the new EU Member States, compared with the total average economic growth of 2.8 percent for the same period.

- EU Automotive industry generates 12 million jobs across Europe, which represents around 5.5 percent of employment in the EU-27.

- Nearly 50 percent of the major manufacturers on the European market prefer CEE to Asia as location for their facilities. Main advantages of CEE are low transportation and labour costs and qualified labour pool.

- Descending utilization of capacity (dropped to 65 percent in 2009) remains an issue.

- The sector is a world leader in premium vehicles, has a strong supplier base, and is among the global technology leaders, due to substantial investments and a demanding home market.

- The overall sector R&D investments (total 24 billion Euros per year), representing about 30 percent of European R&D investments, half of which comes from automotive suppliers.

- Focused and strong investments in ground breaking automotive technologies (battery-powered hybrids, electric vehicles), driven by stricter fuel efficiency regulations, are likely to lead to growth in related components and technologies.

- Joint research projects between industry and public authorities.

- Division between automotive suppliers (split in tiers) and original equipment manufacturers (OEM); 75 percent of vehicle’s original equipment components and technology are sourced. The suppliers sector includes 3000 companies (2500 of which are SMEs with more than 3 million total employees).

**Bulgaria sector development snapshot:**

7.36. Bulgaria’s machine building sector is export oriented. More than 50 percent of production is exported, representing about 10-15 percent of the country’s total exports. More than half of the exported production of the machine-building products are exported to the EU (Germany and Italy are the biggest markets. Total revenue of the sector, as well as revenue from domestic market and from the export is presented in Table 7.7 below. Data for subsectors respective numbers is also presented in the table.

<table>
<thead>
<tr>
<th>Subsectors</th>
<th>Total revenue</th>
<th>Revenue from domestic market</th>
<th>Revenue from export</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 28</td>
<td>71.82</td>
<td>75.37</td>
<td>91.41</td>
</tr>
<tr>
<td>C 25</td>
<td>73.93</td>
<td>82.20</td>
<td>95.26</td>
</tr>
</tbody>
</table>

7.37. Modest innovators and leaders in terms of revenue and employees are the sub-segments ships and floating structures building and the manufacturing of motor vehicles and trailer. Key sector segments in terms of income, number of employees and number of companies are presented in the Table 7.8 below.

Table 7.8: Bulgaria machine building sector development snapshot

<table>
<thead>
<tr>
<th>SEGMENT</th>
<th>INCOME (000, BGN)</th>
<th>EMPLOYEES</th>
<th>COMPANIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of other transport equipment</td>
<td>287,473</td>
<td>11,841</td>
<td>516</td>
</tr>
<tr>
<td>Building of ships and floating structures</td>
<td>167,477</td>
<td>6,801</td>
<td>372</td>
</tr>
<tr>
<td>Manufacture of bicycles and invalid carriages</td>
<td>42,445</td>
<td>947</td>
<td>14</td>
</tr>
<tr>
<td>Manufacture of railway locomotives and rolling stock</td>
<td>38,223</td>
<td>2,788</td>
<td>22</td>
</tr>
<tr>
<td>Manufacture of air and spacecraft and related machinery</td>
<td>35,841</td>
<td>834</td>
<td>69</td>
</tr>
<tr>
<td>Manufacture of motor vehicles, trailers and semi-trailers</td>
<td>66,975</td>
<td>3,955</td>
<td>141</td>
</tr>
<tr>
<td>Manufacture of motor vehicles</td>
<td>26,176</td>
<td>335</td>
<td>18</td>
</tr>
<tr>
<td>Manufacture of other parts and accessories for motor vehicles</td>
<td>23,801</td>
<td>2,892</td>
<td>108</td>
</tr>
<tr>
<td>Manufacture of electrical and electronic equipment for motor vehicles</td>
<td>12,648</td>
<td>494</td>
<td>1</td>
</tr>
</tbody>
</table>


7.38. Despite the economic downturn, the quality combined with the competitive pricing of sector products resulted in an increase of exports of machinery and equipment by 32 percent from 2009 to 2010, and an increase in FDI in the sector of 16 percent for the same period.
Ships and railway equipment

7.39. Competition from abroad is changing the subsector\textsuperscript{116}, resulting in an increase of low value-added repair work and declining high value-added work such as shipbuilding and production of transport machinery and railway equipment. The biggest shipbuilding company – “Bulyard Shipbuilding Industry”, privatized five years ago, is building and repairing ships and offers conversions services has.\textsuperscript{117} Another big local company “Rail trucks repairs – Karlovo” is manufacturing and repairing of railway cars and railway equipment, spare parts production, assembling sets and units for the rolling stock. The company has initiated a large-scale restructuring project in 2010, and is well positioned on the EU market and is subcontractor for some leading companies in EU as AhausAlstaetterEisenbahn - AAE” AG – Switzerland.

Automotive & electronics

7.40. Apart from the shipbuilding sector, Bulgaria has strong traditions in auto components production, but has never been a major regional or global transport equipment producer. Bulgaria’s automobile manufacturing cluster has attracted multinational companies, in the auto assembly and auto parts production area.\textsuperscript{118}

7.41. There are also a number of local companies that are producing successfully electric vehicles components and electric engines for the EU market. This segment developed over time on the basis of an ecosystem of local Bulgarian and multinational firms such as Siemens, Schneider Electric, Hyundai Heavy Industries, Liebherr, ABB, operating in Bulgaria. Largest revenue sub-segments of in Electronics are electronic components, electric domestic appliances, electric motors, generators and transformers, as well as other electronic and electric wires and cables. This has led to significant transfer of technologies and building local innovation capacities.

7.42. In early 2012 the Chinese automotive company Great Wall invested in a car assembly factory near Lovetch, which proved to be only the first Chinese investments in this subsector. Soon after this launch in February 2012, that is a joint-venture between the Bulgarian company Litex Motors and the Chinese Great Wall, a second large Chinese investment project in the field of automotive is about to be implemented in Bulgaria. Chinese BYD Company, a worldwide leader manufacturing electric cars, buses, batteries and LED lighting, and the Bulgarian Bulmineral signed at the end of 2012 a joint-venture

\textsuperscript{116}Building of ships and floating structures, as well as related services as ships and railway equipment repairs, used to generate more than 50 percent of the revenue of the transport equipment subsector.
\textsuperscript{117} Revenues for 2010 are close to EUR40 million; however, the company is generating significant losses due to competition from China.
\textsuperscript{118} A number of local and international companies (like Johnson Controls, EPIQ Electronic Assembly, Montupet, etc.) are producing electronics components for large brands like BMW and Audi.
agreement to build an auto assembly plant. The new established company named Auto Group Motors will be located in the small town of Breznik, some 50 km west of the Bulgarian capital Sofia.

7.43. Another positive signal for the development of the Bulgarian car manufacturing sector is the pending investment in bus and trolleybus assembling plant in Gabrovo by the Ukrainian company “Lviv Bus Plant” (LAZ). R&D potential in the machinery building sector is high, but weaknesses in the education systems, and the lack of financial resources for R&D and innovations, are barriers to realizing that potential.

### Table 7.9: Top 20 growing companies in the Machine Building sector (2010-2011)

<table>
<thead>
<tr>
<th>Company and location</th>
<th>Income growth 2011/2010 (in %)</th>
<th>Income 2011 (000, BGN)</th>
<th>Income 201 (000, BGN)</th>
<th>Net profit 2011 (000, BGN)</th>
<th>Number of employees 2011</th>
<th>Number of employees 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Aisberg International (Sofia)</td>
<td>569.16</td>
<td>6,076</td>
<td>908</td>
<td>135</td>
<td>27</td>
<td>31</td>
</tr>
<tr>
<td>2 Vitte Automotive Bulgaria (Rousse)</td>
<td>444.65</td>
<td>9,526</td>
<td>1749</td>
<td>152</td>
<td>64</td>
<td>33</td>
</tr>
<tr>
<td>3 AltasCopkoLiften (Rousse)</td>
<td>217.04</td>
<td>30,915</td>
<td>9,751</td>
<td>5,319</td>
<td>113</td>
<td>83</td>
</tr>
<tr>
<td>4 Mechatronics (Gabrovo)</td>
<td>199.28</td>
<td>10,361</td>
<td>3,462</td>
<td>3,263</td>
<td>73</td>
<td>63</td>
</tr>
<tr>
<td>5 LemiTrafo (Pernik)</td>
<td>92.44</td>
<td>22,841</td>
<td>11,855</td>
<td>2,790</td>
<td>80</td>
<td>56</td>
</tr>
<tr>
<td>6 KAMT (Karnobat)</td>
<td>91.07</td>
<td>4,706</td>
<td>2,463</td>
<td>9</td>
<td>46</td>
<td>35</td>
</tr>
<tr>
<td>7 KHS-Zagora (Stara Zagora)</td>
<td>85.16</td>
<td>4,179</td>
<td>2,257</td>
<td>643</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>8 2C-Trifonov Sie (Sofia)</td>
<td>84.09</td>
<td>1,712</td>
<td>930</td>
<td>142</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>9 Elika-Elevator (Silistra)</td>
<td>72.53</td>
<td>5,300</td>
<td>3,072</td>
<td>1,917</td>
<td>66</td>
<td>46</td>
</tr>
<tr>
<td>10 SL Industries (Rousse)</td>
<td>70.01</td>
<td>6,333</td>
<td>3,725</td>
<td>94</td>
<td>80</td>
<td>59</td>
</tr>
<tr>
<td>11 Bultex-2000 (Stara Zagora)</td>
<td>64.36</td>
<td>6,045</td>
<td>3,678</td>
<td>542</td>
<td>62</td>
<td>50</td>
</tr>
<tr>
<td>12 Budeshtnost (Tchirpan)</td>
<td>56.96</td>
<td>15,839</td>
<td>10,091</td>
<td>1,413</td>
<td>166</td>
<td>210</td>
</tr>
<tr>
<td>13 BTL Industries (Sofia)</td>
<td>56.53</td>
<td>62,740</td>
<td>40,083</td>
<td>24,888</td>
<td>97</td>
<td>67</td>
</tr>
<tr>
<td>14 Dimex Lift (Plovdiv)</td>
<td>55.32</td>
<td>4,908</td>
<td>3,160</td>
<td>150</td>
<td>60</td>
<td>45</td>
</tr>
<tr>
<td>15 MIG 23 (Sofia)</td>
<td>52.86</td>
<td>8,542</td>
<td>5,588</td>
<td>413</td>
<td>50</td>
<td>47</td>
</tr>
<tr>
<td>16 Sprinter (Montana)</td>
<td>50.17</td>
<td>14,745</td>
<td>9,819</td>
<td>3,564</td>
<td>59</td>
<td>53</td>
</tr>
<tr>
<td>17 Tremol SMD (VelikoTarnovo)</td>
<td>46.62</td>
<td>4,104</td>
<td>2,799</td>
<td>58</td>
<td>144</td>
<td>107</td>
</tr>
<tr>
<td>18 Micotronik (Stara Zagora)</td>
<td>46.44</td>
<td>5,219</td>
<td>3,564</td>
<td>2,452</td>
<td>32</td>
<td>27</td>
</tr>
<tr>
<td>19 Montana hydraulics (Montana)</td>
<td>46.22</td>
<td>7,577</td>
<td>5,182</td>
<td>827</td>
<td>108</td>
<td>88</td>
</tr>
<tr>
<td>20 ZMM Nova Zagora (Nova Zagora)</td>
<td>45.88</td>
<td>4,820</td>
<td>3,304</td>
<td>227</td>
<td>136</td>
<td>124</td>
</tr>
</tbody>
</table>


119 According to the company, the annual assembly capacity in the new plant will be 500 to 800 units, and a total number of more than 600 employees will be hired.

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Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013”, financed under Priority Axis 5 “Technical Assistance” of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
Key challenges in the machine building and electronics sector

7.44. Employment in the sector is declining rapidly. The sector has been heavily damaged by the crisis in Europe, with employment decreasing from about 132,000 in 2008 to less than 114,000 at the end of 2009 on a continuing trend. Another negative trend during the same period is the increasing age of sector employees, with the share of younger workers (under 24 years) falling from 5.4 to 4.6 percent – a loss of about 1500 young workers. Almost 55 percent of all employees are more than 45 years old. The declining number of engineering students and the lower quality of engineering education as a result of the crisis are becoming key issues for the sector.

7.45. There are no local large companies still thriving on the market. The machine building sub-segment is quite fragmented, as most of the large machine building companies from the command economy past dissolved during the past two decades. As a result, most micro and small companies in the sector do not have the critical mass to engage in research and innovation activity. An additional constraint to innovation-based growth is the lack of cooperation among local SMEs because of missing key links in the value chain (metal casting, for example), and deficiency of good collaboration practices and trust among companies. Also, lacking is adequate technological infrastructure and equipment available that could be shared by local SMEs on fee-for-service basis.

7.46. A core constraint is the lack of financial support for commercializing innovations. Targeted public funding for R&D, technology transfer, and commercialization are underdeveloped, EU funding is not effectively used due to slow and cumbersome procedures, resulted in long application process, too formalized requirements. The patenting process is also very slow and cumbersome, and IP rights legislation needs significant improvement, protection of service innovation is non-existent.

Regional development and specialization

7.47. Machine-building and electronics companies are distributed throughout the country. As the most important machine building centers declined after 1989, production is now concentrated in the following areas:

- Plovdiv – electric domestic appliances
- Gabrovo – moulds and hoist production;
- Stara Zagora – food processing machinery and metal processing;
- Kazanluk – hydraulics;

120From all old big state-owned conglomerates in the machine building sector, there is currently only one survived on the market – ZMM Sliven - specialized in designing and production of universal metal cutting lathes, CNC lathes, equipment and spare parts
- Varna, Rousse, Burgas – building and repair of ships and floating structures;
- Sliven – metal processing machinery;
- Panagurishte – optics and precision electronics and engineering;
- Silistra – wood-processing machinery;
- Shoumen – transport machinery building.

7.48. According to the EU cluster observatory, Western-Central and North-Eastern regions are ranked among the top 20 regions for manufacturing of machines. Table 7.10 shows some specialization in different regions, with the strongest specialization being in North East region, focused on ships and boat building and repairing:

Table 7.10: Regional Specialization of the Machine-Building Sector in Bulgaria

<table>
<thead>
<tr>
<th>Industry</th>
<th>Region</th>
<th>In EU</th>
<th>Specialization</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing of machine tools</td>
<td>North-Central</td>
<td>13</td>
<td>2.91</td>
<td>3096</td>
</tr>
<tr>
<td>Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines</td>
<td>South-Central</td>
<td>26</td>
<td>2.19</td>
<td>7239</td>
</tr>
<tr>
<td>Building and repairing of ships and boats</td>
<td>North-Eastern</td>
<td>14</td>
<td>4.63</td>
<td>4311</td>
</tr>
<tr>
<td>Manufacture of electric motors, generators and transformers</td>
<td>North-Central</td>
<td>25</td>
<td>2.33</td>
<td>2168</td>
</tr>
</tbody>
</table>


7.49. The largest sub-segments in terms of revenue generation are the electronics components and electric domestic appliances. \(^{121}\) Sub-segments are represented in more details in Table 7.11 below.

Table 7.11: Key Characteristics of the Electrical Equipment Sector in Bulgaria

<table>
<thead>
<tr>
<th>Electrical equipment sector and the biggest sub-segments</th>
<th>Revenues (000, BGN)</th>
<th>Employees</th>
<th>No. of companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical equipment</td>
<td>991 842</td>
<td>29 291</td>
<td>1017</td>
</tr>
<tr>
<td>Other electrical equipment</td>
<td>125 707</td>
<td>8 645</td>
<td>343</td>
</tr>
<tr>
<td>Electric motors, generators and transformers</td>
<td>198 817</td>
<td>5 268</td>
<td>158</td>
</tr>
</tbody>
</table>

\(^{121}\) In domestic appliances there is a big concentration as this revenue is achieved only by 18 companies and the leader has above 70 percent share of the sub-segment revenue.
Other electronic and electric wires and cables & 188 903 & 4 368 & 54  
Electric domestic appliances & 225 332 & 2 940 & 18  
Electronic components & 280 600 & 5 655 & 151  


**Sector innovation ecosystem**

7.50. The sector has relatively low innovation intensity (seven patents from 2002-2012); however, has significant innovation potential. The main fields of technological innovation intensity based on the number of patents, are internal combustion engines and electrical generators. Local researchers have developed more than 50 patent inventions, most of which are embedded in products and are not even registered.

7.51. There are also examples of local products that compete in the higher value added segment on a global level. For example “Dynamo Sliven” is currently producing one of the most advanced and high-tech car generators in the world, specifically developed for the U.S. market. Another company, “PodemKran” of Gabrovo is part of the top 4 companies producing sophisticated hoists equipment. The products of these, and similar companies, are designed and produced by Bulgarian engineers, based on proprietary innovative solutions.

7.52. **Some clusters in the sector are very well developed** and can be seen as examples of successful growth and cooperation:

- **Mechatronics cluster.** Local companies in this segment are working collaboratively with leading companies from the UK and Germany. For example at the September 2012 International Fair Plovdiv, SPESIMA GmbH - one of the leading cluster company – was awarded a Gold Medal and Diploma in the category “Specialized robots MPS Series for automation of die-casting machines”

- **Electromobiles cluster** –This cluster developed over the years in by targeting highly-specialized niches of the global electromobiles market segment. This cluster represents some of the biggest local companies and promotes cooperation with leading global companies. As a result of the development the first Bulgaria electric charging station has been prototyped successfully, the patenting process is under finalization and this product soon will be ready for commercial production (see Box 7.6: Bulgarian innovation in electromobiles- IKEM Corp.).

**Box 7.6: Bulgarian innovation in electromobiles- IKEM Corp.**

**History of the company**

IKEM Corp. was established in 2011 as a corporate department and business-oriented entity of the main shareholder – a non-profit organization, called Electric Vehicles Industrial Cluster (EVIC)– Bulgaria (www.emic-bg.org).

The company was established with support of the cluster (EVIC) and is a new model (or platform) for cooperation.
within a business cluster network. Since the administrative body of the cluster was registered as a non-profit organization and deals mainly with public activities, such as changing the legal framework, providing the necessary business environment, increasing the public awareness and etc. Corporate-type of organization was established, so that it can concentrate on managing the business activities and projects of the cluster's network. The shareholders of the company are members of EVIC.

**Main areas of activities:**

- R&D, production and management of charging stations for Electric Vehicles
- Development, installation and maintenance of kits for conversion of ICE vehicles to EVs
- Trade representation of equipment, products and services, related to sustainable energy technologies and EV technologies
- Consultancy services in the field of Electric mobility, EV infrastructure, development of business models, development of municipal strategies, etc.
- Trade representation of companies, members of the “Electric Vehicles Industrial Cluster”
- Development of prototypes of Electric Vehicles and other related products;

The company's original idea was to undertake a project for developing Bulgarian charging station and establishing charging infrastructure network within the larger cities of Bulgaria. In addition, it was designed to become a key player in the sales and after-sale services of electric vehicles and other related products on the territory of Bulgaria.

As of December 2012 the company has successfully developed the first model of charging station and has signed partnership agreements with key companies (local and international) for trade of electric vehicles (both personal and light commercial vehicles) and is in the process for developing network of showrooms and service shops in the largest regional cities in Bulgaria.

**Key innovative products:**

The first business project of the entity was to develop the first Bulgarian charging station for electric vehicles (EVs). The project was implemented on cluster-based cooperation – with the participation of different members of EVIC, with different expertise and professional direction.

The project was developed by a specially established working group, which included experts and companies from the cluster network. It included electric and electronic systems engineers, industrial design specialist, standardization and certification expert, marketing specialists, etc. The successful prototype development proved that the implemented method is productive and can be integrated with other projects of the company.

The charging station's innovative features and functions include: unique design, special materials of the stations body – fiberglass; unified management system (including remote monitoring and breakdown notifications), which allows for establishing a network of charging stations and unified payment system with prepay RFID cards. The charging station is equipped with LCD display, which is used for informing the client about the charging process, the amount of prepaid deposit and the energy consumption, as well as for displaying advertisements (which creates additional income for operators of the station or network of stations). These innovative features, design and functions, as well as the competitive price of the product provide a great market potential of the first own product of IKEM Corp.

**Funding:** The product was developed with private funding, financed by the shareholders of the company.

**Key products and Markets:**

The key products of the company are as follows: charging station for EVs, electric passenger vehicles, electric light commercial vehicles, etc. The company's strategy is to service the Bulgarian market by establishing local showrooms and service shops at the largest regional cities as a first stage of development and as a second stage, the
company aims at establishing a network in the SEE region.

**Business associations and organizations:** The company is part of the EVIC’s network and the administrative body of the cluster is the main shareholder. The organization (EVIC) is the only cluster-type organization, related to the electric vehicles industry and has carried out a number of initiatives, aimed at providing strong basis for development of the Bulgarian electric vehicles industry. The organization has implemented series of measures for developing the business environment, legal framework, HR, education and etc. in Bulgaria.

**Business environment:** The general business environment in Bulgaria such as taxation, legal framework, financial state and etc., is conducive to development of the sector in general. Other pro-factors are good quality of HR, relatively low wage levels, strategic Geo-political position and etc.

**Bulgarian leader on the EV market:**

Since IKEM Corp. operates in a highly competitive environment and business, which is innovative by its nature, the future development of the company depends on its innovative spirit and ability to offer products and services that will provide added value to its clients, Bulgarian EV industry and society. Providing that these factors are covered, IKEM Corp. has a great potential to become a leader in EV and related products and services market in Bulgaria and other countries of the region.

7.53. There are some good examples for cooperation between the universities and business organizations. The missing links are R&D centers, which have key role for technology transfer, research activities and scientist and human capital formation through research experts’ development. The applied science institutes available in Bulgaria, used to play this roles, but after their closure, there is a missing link in the innovation value chain. However there are some good examples that new engineering disciplines are adopted by the universities – for example a new “Electromobiles” major will be taught in Technical University Rousse and Pernik University.

7.54. There is lack of instruments and financial resources supporting innovation ideas, commercialization of research and successful implementation in the production processes. Unfortunately, there are no spin-offs from universities and R&D centers that engaged in the successful commercialization of innovations.

**Sector opportunities and scenarios**

7.55. Bulgaria could become a gateway to Europe for companies from Asia. As Far East countries are expected to play more and more significant role (for example, China is expected to become the largest car manufacturer in the future, with light vehicle production reaching almost 16 million units in 2015), Bulgaria could target producers from China, Japan, Korea and India to locate vehicle components production in the country. Asian companies are also interested in investing in assembly operations in Bulgaria, which could be a driver for further technology transfer and investments in R&D. The consecutive two investments in Bulgaria by China’s biggest companies could also be leveraged to attract other investments.

7.56. Bulgaria could become a link in the supply chain for some growing Far East and Western Europe industries with high innovation intensity and strong cross-industry effects. In Europe, investments in ground breaking technologies such as battery-powered hybrids and electric vehicles are expected to
increase significantly; and some assembly or production activities could be outsourced to Bulgaria if it offered a high-quality workforce and a good efficiency/cost ratio. With its capacity for manufacturing of mechanical components and electronics, Bulgaria has an opportunity to be embedded in the emerging automotive industry cluster known as CleanTech.\(^{122}\)

7.57. A potential scenario for the country could be to follow a niche market strategy, by focusing on key areas such as electronics, automobile components, mechatronics, and hydraulics. Based on the number of patents issued in the machine-building sector over the past two years, the highest technological innovation intensity will likely occur in the areas of internal combustion engines, electrical generators, LED lighting, and hydraulics.

Table 7.12: SWOT Analysis – Machine-Building and Electrical Equipment Sector

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Strong export orientation and successes in markets in Western Europe, the Middle East and the CIS</td>
<td>- Ageing workforce</td>
</tr>
<tr>
<td>- Presence of successful international companies providing technology transfer and dissemination that can spur the next level of innovation-driven growth</td>
<td>- Declining number of students in engineering and devolving quality of engineering higher education.</td>
</tr>
<tr>
<td>- Successful pilot clusters developing products in the highest value-added market segments, such as automotive components and electronics, electro mobiles, LED lighting, advanced hydraulics</td>
<td>- Low and ineffective R&amp;D spending (as measured by the number of patents)</td>
</tr>
<tr>
<td></td>
<td>- Engineering education in need of upgrading</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>- There are key areas where BG is highly competitive (precision engineering and electronics, LED lighting, hydraulics) where with targeted support there is the potential to develop specialization as a niche player and “plug” into the global value chain, through partnering with leading companies.</td>
<td>- Increased competition from Asia due to outdated technology infrastructure and equipment depleting competitive advantages associated with proximity to large markets, low tax burden and low labor costs through exceptionally high energy and water resource costs</td>
</tr>
<tr>
<td>- Leverage cooperation with key EU R&amp;D centers in the EU and abroad, to further develop local R&amp;D capacity and increase the technology absorption.</td>
<td></td>
</tr>
</tbody>
</table>

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\(^{122}\)CleanTech is an emerging cluster industry, which incorporates a number of sub-industries (manufacturing of mechanical components, electronics, chemistry and biotech).
E. Pharmaceutical sector

7.58. Europe’s pharmaceutical industry has a complex structure due to the large variety of stakeholders, significant involvement of government, and high degree of regulation aimed at promoting public health and keeping public expenditures under control. The sector is driven by R&D and requires substantial IPR protection (ECORYS 2009). According to IMS Health (2010), five European pharmaceutical companies are placed in the top 10 list of lead global companies with over US$32 billion of revenue – Novartis from Switzerland is 3rd, Sanofi-Aventis from France is 4th, GSK and Astra-Zeneca from the UK are 5th and 6th, while Roche (+Genentech) is 7th. At the same time, Europe is the second biggest market after US with over US$260 billion of sales in 2009.

7.59. The global financial crisis had a severe impact on the pharmaceutical industry in Europe. As a result, since 2011:

- Governments have been cutting public expenditure for medicine and are less likely to pay for innovative medicines;
- In four countries alone, the industry is owed more than 12.5 billion EUR in unpaid bills;
- Fast-growing and emerging economies continue to be serious competitors.

The pharmaceutical industry in Europe is by far the largest pharmaceutical industry in the world, with a substantial contribution in terms of R&D activities, employment, and trade. In spite of its financial difficulties, it continues to surpass all other industries in R&D investments (ECORYS (2009). *Competitiveness of the EU market and Industry for Pharmaceuticals*. Prepared for the European Commission, Directorate General Enterprise & Industry. December 2009, Rotterdam.)
7.60. Figure 7.1). The EU remains the second largest market for investment in pharmaceutical R&D, and the industry contributes more than EUR7 billion in savings to the national budgets of Greece, Ireland, Italy, Portugal, and Spain through price cuts and discounts. In addition, the pharma industry employs about 660,000 people in Europe (2011), of which more than 20 percent work in R&D. As a result, the industry provides the highest value added per employee, as per EUROSTAT. The industry contributes EUR48 billion to the EU’s trade surplus, which is the most significant contribution to the trade balance. Finally, 77 percent of the production by the world’s largest vaccine manufacturers is carried out in Europe.\textsuperscript{124}

\textsuperscript{124} For more information, see European Federation of Pharmaceutical Industries and Associations at www.efpia.eu.
Figure 7.1: Pharmaceuticals and Biotechnology Top the List of R&D Investment (2009, b. EUR)


7.61. In Bulgaria, the pharmaceutical industry has changed enormously since 1990, from a fully vertically integrated sector involved in developing, producing, and licensing patented medicines, to a manufacturing hub concentrating on generic pharmaceuticals, and facing increasing competition from foreign multinational and generic entrants. Overall, drug consumption in Bulgaria has grown more than threefold since 2000. However, consolidation has resulted in market synergies through backward and forward integration and strategic partnerships on a local and international scale.

Table 7.13: Bulgaria pharmaceutical sector development snapshot

<table>
<thead>
<tr>
<th>Segments</th>
<th>Income (000 BGN)</th>
<th>Employees</th>
<th>Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmaceutical market at retail prices</td>
<td>2 200 000</td>
<td>6,500</td>
<td>41</td>
</tr>
<tr>
<td>Marketing authorization holders</td>
<td>1 430 000</td>
<td>1,300</td>
<td>24</td>
</tr>
<tr>
<td>Pharmaceutical producers</td>
<td>770 000</td>
<td>5,000</td>
<td>17</td>
</tr>
<tr>
<td>Pharmacies</td>
<td>1 914 000</td>
<td>5,000</td>
<td>4,000</td>
</tr>
</tbody>
</table>

Source: IMS Health data and estimates from ARPharm and BG Pharma, 2013.

Today, the pharmaceutical industry is among the fastest growing sectors in the Bulgarian economy, characterized by relatively cost-efficient and high-quality production at a competitive price without a high level of R&D expenditures. The harmonization of Bulgarian pharmaceutical legislation with EU regulations has resulted in considerable investment by Bulgarian and foreign producers in boosting production capability and modernizing facilities to create competitive advantage. Moreover, foreign multinational companies have begun to enter the market, either through the acquisition of Bulgarian pharmaceutical manufacturers or through local distributing companies (
7.62. Figure 7.2).
Figure 7.2: FDI in percent of GDP

Source: UNCTAD FDI online data and World Bank WDI database

**Key sector characteristics and recent developments**

7.63. The Bulgarian pharmaceutical market is one of the smallest in EU, but it has grown substantially over the past few years. The market reached BGN 2,098 million in 2011 (Table 7.14), a 12 percent increase compared to 2010, and an 18 percent increase compared to 2009 (2012 IMS Health). Drug expenditure accounts for 2.45 percent of GDP, the highest in EU with the exception of Greece. Business Monitor International forecasts that the market will continue to grow in 2010-2013 with Compound Annual Growth Rate of 9.1 percent. Generic drugs accounted for more than 50 percent of sales in volume terms and more than 80 percent in value terms in 2011. The most important market is the pharmacy segment, which accounts for about 90 percent of the total. About 30 percent of the OTC market is for flu and cough medicine.

Table 7.14: Bulgarian Pharmaceutical Market (million BGN)

<table>
<thead>
<tr>
<th></th>
<th>Value, 2011</th>
<th>Value, 2010</th>
<th>Value, 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>2,097.7</td>
<td>1,875.9</td>
<td>1,719</td>
</tr>
<tr>
<td><strong>Pharmacy</strong></td>
<td>1,824.6</td>
<td>1,600.5</td>
<td>1,400.4</td>
</tr>
<tr>
<td><strong>Hospitals</strong></td>
<td>273.1</td>
<td>275.4</td>
<td>254.9</td>
</tr>
<tr>
<td><strong>OTC</strong></td>
<td>338.6</td>
<td>294.9</td>
<td>262.4</td>
</tr>
</tbody>
</table>

Source: IMS Health (2012), estimates by the author.

7.64. The top pharmaceutical companies in Bulgaria have achieved substantial growth since recovering from the global financial crisis. According to the Bulgarian Drug Agency (BDA), about 100 companies set up production and/or trade facilities in 2011. The main domestic drug manufacturers are Actavis, Sopharma, Biovet, Unifarm, NIHFI, Chaikapharma, Bu-Bio, the National Center for Hematology and Transfusion, Inbiotech, Biomeda and Vet Prom. Foreign companies are represented either by local subsidiaries, which produce drugs under license, or by offices with 10 to 30 employees who carry out only trade, marketing activities, and clinical trials. GSK and Novartis, for example, have only trade and clinical trials operations. As of 2004, there are more than 100 foreign pharmaceutical companies represented in Bulgaria.
Table 7.15: Top 15 Pharmaceutical Companies in Bulgaria

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2010</th>
<th>% Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actavis</td>
<td>157</td>
<td>133</td>
<td>9.1</td>
</tr>
<tr>
<td>Novartis</td>
<td>148.7</td>
<td>119.2</td>
<td>24.8</td>
</tr>
<tr>
<td>GlaxoSmithKline</td>
<td>140.5</td>
<td>108</td>
<td>30</td>
</tr>
<tr>
<td>Roche</td>
<td>135.3</td>
<td>130.1</td>
<td>4</td>
</tr>
<tr>
<td>Sopharma</td>
<td>113.7</td>
<td>109.4</td>
<td>4</td>
</tr>
<tr>
<td>Sanofi-Aventis</td>
<td>102.2</td>
<td>115</td>
<td>-11.1</td>
</tr>
<tr>
<td>Servier</td>
<td>88.5</td>
<td>81.1</td>
<td>9.2</td>
</tr>
<tr>
<td>Pfizer</td>
<td>85.1</td>
<td>68.2</td>
<td>24.8</td>
</tr>
<tr>
<td>AstraZeneca</td>
<td>75.8</td>
<td>62.1</td>
<td>21.9</td>
</tr>
<tr>
<td>Bayer</td>
<td>69.7</td>
<td>64.4</td>
<td>8.2</td>
</tr>
<tr>
<td>Abbott</td>
<td>59.2</td>
<td>53.7</td>
<td>10.3</td>
</tr>
<tr>
<td>Menarini</td>
<td>53.1</td>
<td>51.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Novo Nordisk</td>
<td>47.2</td>
<td>44.1</td>
<td>6.9</td>
</tr>
<tr>
<td>MSD</td>
<td>44.4</td>
<td>47.2</td>
<td>-5.9</td>
</tr>
<tr>
<td>Chaikapharma</td>
<td>43</td>
<td>38.8</td>
<td>10.9</td>
</tr>
</tbody>
</table>

Source: Weekly Capital, 3 February 2012.

7.65. Privatization and consolidation have led to faster return on investment and industry growth. Major local drug manufacturers were privatized in the late 1990s, and many of those companies have consolidated. With the adoption of Good Manufacture Practice in 2002, in preparation for EU accession, most remaining companies have made large investments in modernization.

7.66. The Pharmaceuticals sales sector is one of the most profitable sectors in Bulgaria (Table 7.16).

Table 7.16: Leading Trade Companies in terms of Profits (2010)

<table>
<thead>
<tr>
<th></th>
<th>No. of firms</th>
<th>Profit, EBITDA** (000 BGN)</th>
<th>% of EBITDA as share of Industry</th>
<th>Turnover (000 BGN)</th>
<th>% of turnover as share of other services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharma sales</td>
<td>8</td>
<td>214 775</td>
<td>30.2%</td>
<td>1 767 172</td>
<td>13.3%</td>
</tr>
<tr>
<td>Trade with FMCG*</td>
<td>5</td>
<td>105 982</td>
<td>14.9%</td>
<td>1 557 321</td>
<td>11.8%</td>
</tr>
<tr>
<td>Fuel Trade</td>
<td>5</td>
<td>102 693</td>
<td>14.4%</td>
<td>6 664 443</td>
<td>50.3%</td>
</tr>
<tr>
<td>Metals Trade</td>
<td>5</td>
<td>47 517</td>
<td>6.7%</td>
<td>363 146</td>
<td>2.7%</td>
</tr>
<tr>
<td>Auto and Motorcycle Trade</td>
<td>5</td>
<td>38 530</td>
<td>5.4%</td>
<td>503 898</td>
<td>3.8%</td>
</tr>
</tbody>
</table>

**EBITDA – earnings before interest, taxes, depreciation and amortization.
7.67. The top five trade companies, with more than BGN25 million of EBITDA, are in fact drugs traders. Companies such as Rompharm Ltd., which wholesales pharma products, and Huvepharma (fast-growing global pharmaceutical company), are among the top five trade companies in Bulgaria. 125

7.68. Some of the small and medium-size pharma companies specializing in trade are among the most dynamic companies in Bulgaria. For example, Astelas Pharma, a Sofia-based trade company with 19 employees (compared to 16 in 2010), is ranked 81st by the Bulgarian CAPITAL weekly. Its revenues were BGN5.1 million in 2011, a 161 percent increase over the previous year. Its net profit is estimated at BGN134,000. Cherneva Pharm was ranked 94th. This Varna-based trade company employs 55 people in 2011, compared to 47 in 2010. It has achieved BGN 11.2 million of revenues in 2011, which is 151 percent growth compared to previous year. Its net profit is estimated at BGN558,000. Varna is ranked number two (after Sofia) in terms of number of enterprises per 1000 people (as of 2010) – in fact, 71 per 1000, compared to 85 per 1000 in Sofia, and number three in terms of FDI inflow – EUR1.5 billion, compared to EUR12.5 billion in Sofia. Varna is also the second city in Bulgaria in terms of share of University graduates – 25.6 percent, compared to 44.8 percent in Sofia.

7.69. In terms of manufacturing, Sopharma JSC is the leading drug producer in Bulgaria (Table 7.17). Actavis, the parent company of Balkanpharma JSC in Dupnitsa and Balkanpharma JSC in Troyan, is the second largest, producing about 250 pharmaceutical products. Actavis, formerly owned by Icelandic Pharmaco, was recently acquired by a US company. The Icelandic company also owned Higia EAD, one of the leading pharmaceutical distributors in Bulgaria, with a network of about 2,000 pharmacies and a 20 percent market share, but sold it in 2009 to a private investor. Actavis exports about 60 percent of its production, mainly to CIS countries.

Table 7.17: Leading Producers of Drugs and Products

<table>
<thead>
<tr>
<th>Company Name</th>
<th>EBITDA (000 BGN)</th>
<th>Profitability (%)</th>
<th>Trade Revenues (000 BGN)</th>
<th>Profit before taxes (000 BGN)</th>
<th>ROE (%)</th>
<th>Coefficient of indebtedness</th>
<th>Number of employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sopharma JSC</td>
<td>54 874</td>
<td>23.7</td>
<td>231 294</td>
<td>45 680</td>
<td>12.3</td>
<td>0.6</td>
<td>1913</td>
</tr>
<tr>
<td>Balkanpharma Dupnitsa JSC</td>
<td>23 581</td>
<td>14.2</td>
<td>165 638</td>
<td>23 398</td>
<td>7</td>
<td>0.1</td>
<td>935</td>
</tr>
<tr>
<td>BIOVET JSC</td>
<td>10 414</td>
<td>8.3</td>
<td>124 927</td>
<td>2 442</td>
<td>3.1</td>
<td>1.5</td>
<td>1015</td>
</tr>
<tr>
<td>ChaikapharmaMA JSC</td>
<td>7 529</td>
<td>20.7</td>
<td>36 353</td>
<td>5 281</td>
<td>11.1</td>
<td>0.4</td>
<td>80</td>
</tr>
</tbody>
</table>

125 In fact, Romharm Company Ltd is 14th in the 2011 list of profitable companies in Bulgaria with BGN115 million EBITDA (-12.6 percent change compared to 2010), followed by Sopharma JSC, taking 22nd position with BGN54.9 million EBITDA (-12.2 percent change, compared to 2010), while Huvepharma JSCT is 33rd with BGN41.1 million(13.8 percent change).
Balkanpharma Troyan JSC

<table>
<thead>
<tr>
<th></th>
<th>6160</th>
<th>19.8</th>
<th>31,098</th>
<th>3,712</th>
<th>7.7</th>
<th>0.2</th>
<th>330</th>
</tr>
</thead>
</table>


Figure 7.3: BG Exports of Pharma Products Increased in 2009

7.70. Pharma exports have increased sharply over the past five years, and now account for 3 percent of Bulgaria’s overall export basket. The major importers of Bulgarian drugs are Russia (27 percent of total exports), Romania (11 percent), Croatia (8 percent), Ukraine (7 percent) Germany (6 percent), and Serbia (6 percent). Actavis and Sopharma have substantial exports of generic drugs to Russia and CIS countries. This could signal a turning point for their regional competitiveness.

7.71. Drug manufacturing in Bulgaria focuses on generic medicine, which is one of the most competitive sectors in Europe. Generics account for 50 percent of the volume share and only 18 percent of the value share of the European pharmaceutical industry, according to the European Generic Medicines Association (EGA). The sector employs 150,000 people in Europe (about a quarter of overall pharmaceutical employment) in more than 1,000 companies. The generic medicines they produce bring about EUR 30 billion of savings per year in the EU-27.

7.72. The world’s leading pharmaceutical companies invest between EUR4.5 billion and EUR6.5 billion in R&D activities per year. In fact, Roche – Switzerland, Pfizer-USA, Novartis – Switzerland, Johnson & Johnson – USA, and Sanofi-Aventis- France were among the top 10 R&D investors in the

world in 2009. Since generics manufacturers can price their products very competitively, the lead pharmaceutical companies face the challenge of how to intervene in domestic markets in order to delay the production of generic products after their patent expires. Interventions can include administrative hurdles, court proceedings, pricing, and reimbursement.

7.73. Overall, the Bulgarian pharmaceutical industry generates only about 25,000 jobs, of which about 3,000 are in R&D, research, and clinical trials. Large domestic producers, such as the foreign-owned Actavis and the domestically owned Sopharma, spend only a small fraction of their annual turnover (about 5 percent) on development activities. The majority of studies undertaken by Bulgarian companies remain focused on proving bioequivalence between generic and patented drugs.

7.74. In sum, Bulgarian drugs producers have profitable positions due to the expansion of the domestic and export markets. The domestic market is among the smallest in the EU, with dominance (over 90 percent) of the pharmacy market segment. Bulgarian producers have substantially modernized their production facilities, but R&D is not a priority.

**Key challenges in the sector**

7.75. The Bulgarian pharmaceutical industry faces three main sets of challenges:

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128 As reported in the new IMS 2010 report on Bulgaria, the Bulgarian market in 1989 constituted only 1 percent of originals. Since 2006, the Bulgarian market for originals has been growing, reaching 24 percent share by June 2010. In mid-2011, it had 21 percent share (IMS Health, August 2011).
129 Official data are not available for Bulgaria and what is provided here is an approximation, based on interviews carried out in June-July 2010 and in February-March 2011 in Bulgaria.
130 The clinical trials in Bulgaria have increased lately, as lead multinational companies have outsourced this activity in Bulgaria due to the cheap cost. In fact, there are about 140 clinical trials per year, each costing about EUR50,000 (total budget per annum, ca: EUR7 million). The clinical trial usually goes through four phases, taking about five years (see EFPIA 2010 report on the Pharmaceutical industry in Europe). About 10 companies deal with clinical trials in Bulgaria engaging local researchers and this does not mean necessarily that the research results are employed by local R&D labs or R&D centers. On the opposite, the local 10 companies have limited staff and they are primarily engaged in administering the clinical trial phases. In fact, just few of the local Bulgarian producers have small R&D labs and they do not cooperate with the lead multinational companies.
131 A budget of EUR1-2 million per year for development activities is the standard for large Bulgarian generics producers, as opposed to multibillion budgets of lead multinational companies in the pharmaceutical industry.
132 The pharmaceutical industry in Bulgaria has always focused on development activities, even during the socialist period. It is well known to experts that there are substantial forms of innovations in the generic products. However, research activities to develop innovative molecules have never been a priority in Bulgaria due to the high investment (EUR1 billion on average per molecule), which is a process, involving also development that runs for 10 years of R&D, excluding the administrative procedures.
133 The World Bank held a focus group for the pharmaceutical industry on November 7, 2012, which brought together about 30 representatives of foreign and domestic producers and traders, as well as representatives of academia and research institutes. Government participated as well through the Ministry of Health, Ministry of Education, Youth and Science, Ministry of Economy and Energy and others.
- Administrative hurdles to entering the market on Day One after a patent expires. There are substantial regulatory delays (even greater than the official figures shown in Figure 7.4.134) This is contrary to EU legislation, which states that marketing authorization should be based solely on quality, safety, and efficacy data and not on other criteria. Transparency Directive 89/105/EEC, which has already been transposed into Bulgarian law, sets a maximum of three to six months for pricing and reimbursement decisions, but this does not preclude member states from establishing faster procedures.

- Distribution of poor quality medicines on the Bulgarian market by third countries. Many small and medium-sized generics producers in Bulgaria purchase medical dossiers from companies in China, India, Turkey, and the Middle East, rather than invest in their own R&D. Many of these products do not meet European standards. Nevertheless, the companies register them with the Bulgarian Drug Agency and offer them on the Bulgarian market, which undermines Bulgaria’s reputation for high-quality pharmaceuticals. In interviews, producers stated that the Drug Agency often makes hasty decisions, especially for these third-country products. Drug Agency lacks the administrative capacity and is not able to offer competitive compensation to external experts to assess these products. As a result, Bulgaria’s Drug Agency is not qualified to offer European Community Registration Procedures for its pharmaceuticals.

Figure 7.4: Time Delays in Price and Reimbursement


134 As per interviews with domestic generic producers in Bulgaria, delays to registration of generic medicine are often caused by the Bulgarian Drugs Agency. In addition, there are delays with the Pricing and Reimbursement process model in Bulgaria, involving authorities, like the Bulgarian Committee for the Positive Drug List and the associated reimbursement procedures of the National Health Insurance Fund and the Ministry of Health, as well as the Bulgarian Pricing Committee at the Ministry of Health.
7.76. Existing national and international instruments to support R&D are not fully utilized. Few Bulgarian pharmaceutical companies or research organizations, including the Bulgarian Academy of Sciences, medical universities, and the chemistry and pharmacy faculties at Sofia University, take advantage of national or EU support instruments that provide grants for R&D development activities.\textsuperscript{135} There are several reasons for this, including the deficient program implementation, specifically at the stages of selection and reimbursement.\textsuperscript{136}

7.77. Lack of collaboration in the knowledge triangle. Research institutes in Bulgaria cooperate mainly with foreign companies and research networks. There is very limited cooperation with Bulgarian firms, which are reluctant to contract with medical universities or research centers. There are a few cases in Bulgaria, though, which generate high potential for commercialization of research activities (Box 7.7).

\textsuperscript{135} These instruments include the National Science Fund, National Innovation Fund, schemes under the OP Competitiveness initiative and the FP7 R&D program in life sciences, and the new Innovative Medicines initiatives.

\textsuperscript{136} Interviews with grant applicants from the pharmaceutical industry and supporting research institutes and universities.
Box 7.7: High Potential for Commercialization of Research Activities - Department of Chemical Engineering (DCE) of the Sofia University Faculty of Chemistry and Pharmacy

History and Development

DCE was initially founded in 1983 as independent laboratory for research and education in the Faculty of Chemistry, Sofia University. In these initial years, the activity of the staff was focused mostly on scientific (academic) studies and education in the area of physical chemistry. However, some applied studies with surfactants, foams and emulsions, were made in collaboration with the Institute of Industrial Chemistry (now not existing, at that time under the umbrella of the Ministry of Economy) and several Bulgarian companies, such as Verila and Yambolen. In this period, the laboratory had around five people permanent staff and around 10 PhD and undergraduate students, deeply involved in the studies and education.

After the changes in 1989, the Bulgarian companies lost possibility to fund research projects and the laboratory re-directed its activity toward several international projects - some of them for education (TEMPUS projects funded by EC), others for research (COPERNICUS project funded by EC, project funded by the Japanese Research and Development Corporation), and some applied projects with external companies, like Kraft Foods and Colgate Palmolive. In this way, the laboratory sustained the difficulties of the 1990’s and it maintained a permanent staff of around 6-7 people, plus 15 PhD and undergraduate students. This model was very successful initially, with well recognized international scientific achievements, however, it turned out to be unsustainable for two main reasons: (i) poor living standards forced most of the young colleagues to leave Bulgaria, and (ii) funding came on a non-regular basis, primarily from abroad, given that Bulgarian sources of funding for research were literally missing.

In the beginning of 2000’s the laboratory started partnering with multinational companies which outsourced research activity in the topics, where the laboratory staff had a specific expertise – surfactants, emulsions, foams. Some new topics were also developed, mostly driven by the demand of the partnering companies – e.g. biophysics of digestion and natural molecules with specific functionality.

As a result, the budget and staff of the lab increased substantially. At present, the lab has seven researchers as permanent staff and around 35 post docs, PhD students and undergraduate students, all of them deeply involved in the academic research and the work on projects with the international companies.


Awards

In all these years, the researchers in the department have been among the leaders in the area of natural scientists in Bulgaria. In fact, the research team has published over 130 publications in prestigious journals since 1966 (50 percent of those have been published after 2000 in international journals, like Langmuir (journal of American Chemical Society), Journal of Colloid and Interface Science, Colloids and Surfaces (Elsevier), and Cambridge University press, among others. Prof. Peter Kralchevsky is currently the youngest active academician in Bulgaria (at the age of 56). Prof. Nikolai Denkov (in his 50s) received in 2010 the highest national award for scientific achievements “Pythagoras”. Prof. Krassimir Danov received a prestigious Bessel fellowship of the German Science Foundation. Associate Professors Krastanka Marinova and Slavka Tcholakova received prizes from the University of Sofia as excellent young scientists. In the meantime, all these researchers are engaged in the education of students in the Faculty of Chemistry (giving courses on Mathematics, Transport Phenomena, Mechanics of Fluids, Rheology, Chemical Kinetics, Surfactants, Disperse systems, Separation processes, etc.) and are leading numerous international projects, mostly with companies. Finally, the senior staff of the lab is frequently invited to present the results of their research at international conferences.
their scientific studies at international research conferences in Europe, USA, Japan, or China. These conferences provide a lot of opportunities for contacts with the international private business.

Partnerships with the Private Business

The lab developed a new module for scientific instrument with the German company Krüss (on the world market since 2008) and several international patents were filed by our partners (BASF, Krüss, Saint Gobain, Unilever).

Figure 2. Dimensionless total viscous stress as a function of the capillary number for foams formed in BS + Jaguar solutions.

The module developed in collaboration with Krüss (world leader in the production of instruments for investigation of the properties of surfaces and interfaces) allows one to measure the so-called “surface modulus” of surfactant solutions. As shown in the studies performed in the department (in collaboration with other companies like Unilever) this surface modulus affects numerous properties of foams, such as their stability, bubble size, rheological behavior, etc. Therefore, the Bulgarian scientists were able to show that, by selection of appropriate surfactants and characterization of their solutions by the new scientific instrument, one could formulate appropriate surfactant mixtures with beneficial applications in personal care, home care, laundry, etc. (relevant to Unilever).


Figure 3. Sketch of an oil drop situated above a horizontal solid plate immersed in a water phase

In another series of experiments, the Bulgarian scientists studied the selection of appropriate emulsifiers and homogenizers to obtain emulsions with desired properties. Such emulsions could be used in various applications, such as paint production, food manufacturing, chemical industry, etc. Some of these applications are relevant to BASF and Unilever (partners in several projects of the department).


Funding from National Instruments

In the period 2008-2012 DCE had three projects with the National Science Fund (NSF). These involved fundamental science but still focused on topics, related to the development of new materials and improvement of technologies, relevant to food products and detergency. In the past couple of years, the work of NSF has been problematic, involving several protests, the most recent being in December 2012 when the scientific community asked for the resignation of NSF management. The DCE scientists never approached the National Innovation Fund or OP Competitiveness since they claim they have heard a lot of negative noise from other scientists about the functioning of these instruments.

Regional and sector specialization

7.78. The production of pharmaceuticals is heavily concentrated in five locations – Dupnitsa, Razgrad, Sofia, Troyan, and Varna, while the trade offices of multinational companies are concentrated predominantly in Sofia. In terms of sector specialization, increasing the potential for R&D activities could be focused on extending the clinical trials segment in the pharmaceutical value chain in Bulgaria.
Figure 7.5: Pharmaceutical Value Chain

**DISCOVERY**
- RESEARCH
- BIOLOGICAL IDENTIFICATION, VALIDATION, SCREENING, OPTIMISATION

**PRODUCT DEVELOPMENT**
- DESIGN
- PRE-CLINICAL & CLINICAL TRIALS, SUBMISSION FOR REGULATORY APPROVAL

**MANUFACTURING**

**MARKETING**
- DISTRIBUTION, SALES TO CONSUMERS

**THE BIG PHARMACEUTICAL FIRMS (FIZER, JOHNSON & JOHNSON, MERCK, ETC.)**
- VERTICALLY INTEGRATED
- HORIZONTAL CONTRACTING/OUTSOURCING

Source: IBM Business Consulting Services.

7.79. Multinational pharmaceutical companies typically contract with smaller biotech companies or universities to carry out research and clinical trials. Many of these contracts are currently going to India and China, where costs are relatively lower than in Europe or the United States. Bulgaria companies could also target the market for clinical trials, which would not only generate revenues but also help these companies to gain support for their own research and for marketing their innovative products (Figure 7.6).

Figure 7.6: Drug Attrition

Source: Baden-Württemberg.

7.80. Marketing prescription drugs in particular is something that requires a highly complex, pre-established network. The big pharmaceutical companies have already spent large amounts of time and resources to set up these networks domestically and abroad. It would be very difficult, if not impossible, for a small biotech firm to effectively market its product, especially to markets outside of its home country. The pharmaceutical companies have the connections and sales teams most capable of handling this capacity. There may be a shift in the future towards an increasing focus on the higher value-add functions of marketing and sales in the big pharmaceutical companies.
7.81. This means that the small biotech firms in Bulgaria, possibly placed in the future Sofia Tech Park, which will start operation in 2015, and the big pharmaceutical companies can both profit from the relationship. The biotech firms can have their innovations marketed through the most efficient and profitable channels, and the pharmaceutical firms can contract out for research that can be done for much lower costs.

**Sector ecosystem**

7.82. Bulgaria’s pharmaceutical industry has benefited from a substantial amount of foreign investment, even during the financial crisis, much of it going to improve the production facilities of drug manufacturers. However, this investment has had little impact on the pharmaceutical ecosystem, due to the lack of connection between Bulgarian businesses and researchers, most of who partner with foreign companies, institutes, and universities. The trade offices of large multinationals also arrange with local hospitals to use their facilities for clinical trials. The Sofia Tech Park, with its plans to focus on R&D in the life sciences, should make a significant contribution to the sector ecosystem.

**Sector opportunities and scenarios**

- Removal of unnecessary administrative and regulatory delays for the introduction of new generics on the Bulgarian market. In this way, Bulgarian generic producers would invest more in development activities if they are confident that their medicine will enter the market on day one after the patent expiry;

- Strengthening of the scientific capacity in research organizations and companies would require the recruitment and retaining of young Bulgarian scientists and attracting internationally-recognized experts that can redirect the research agenda into competitive areas within the generic medicine sector or expanding the phases of the clinical trials that are run in Bulgaria;

- Increased administrative capacity and expertise of the Bulgarian Drug Agency through partnerships with best performers in Europe like the Denmark Drug Agency and the German Drug Agency and tightening the control for distribution of generic medicine of doubtful quality on the Bulgarian market;

Source: Baden-Württemberg.
Targeting new funding schemes in the future OP Innovation and Entrepreneurship 2014-2020, for example, competitive matching grants supporting private sector in early stage of development activities (investment in machinery and equipment, as well as in research), so that Bulgarian companies’ export of generic products can become more competitive in Europe, Russia and the CIS market. Finally, there is a need to support the clinical trials in Bulgaria, which generate good revenue, raise expertise through involvement of hospitals and researchers. A potential extension of the clinical trials phase could be considered for support by the national funding instruments (national innovation fund and the national science fund), as well as future OP “Innovation and Entrepreneurship”.

Table 7.18: SWOT Analysis – Bulgarian Pharmaceutical Industry

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Strong traditions in pharmaceutical research and drug production, good medical research base, highly qualified researchers</td>
<td>- Poor collaboration between pharmaceutical companies, medical research institutions and universities</td>
</tr>
<tr>
<td>- Local pharmaceutical companies with modern and EU compliant manufacturing facilities that are successful in exporting generic drugs</td>
<td>- National funding for research is limited and EU financial resources are not used effectively</td>
</tr>
<tr>
<td>- Potential for innovation and R&amp;D collaboration with international partners in new drug and medicinal compound production and associated early stage clinical trials leveraging the presence of multinational pharmaceutical companies</td>
<td>- Limited experience in R&amp;D associated with new drug development and early stage clinical trials activities</td>
</tr>
<tr>
<td>- High export volumes of generic drugs to markets in Western Europe, Russia and CIS and the Middle East</td>
<td>- Limited connectivity of Bulgarian research networks with European Research Platforms and insufficient knowledge and information exchange</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Exploring established markets for generic drugs in Western Europe, Russia and CIS and the Middle East for exports in the higher value-added market segment: new drugs, medicinal compound, medicinal ingredients delivery systems to markets</td>
<td>- Strong dependency on generic drugs - competition from Asian companies in the generics drugs segment could have negative impact on the sector</td>
</tr>
<tr>
<td>- Qualified researchers, well developed medical research base at hospitals is an opportunity to engage in all stages of clinical trials for developing new drugs, medicinal compounds and ingredients delivery systems</td>
<td>- Onerous business regulation/high barriers to entry of new generic products on the market</td>
</tr>
</tbody>
</table>

F. Information and Communications Technology Sector

**Key sector characteristics and recent developments**

Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013”, financed under Priority Axis 5 “Technical Assistance” of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
2011 EU sector snapshot

- General characteristics of the sector:
  - Heavily concentrated
  - High innovation intensity
  - High R&D intensity
- The ICT sector employees 6.6 million people across EU-27, of which 1.6 million (24.5 percent) work in the ICT manufacturing sector, and 5 million are employed in the ICT service sector
- The EU ICT sector was worth EUR670 billion in 2007 and represents around 5.3 percent of total GDP
- Software has an 11 percent share, IT services 21 percent, and carrier services 44 percent of the total ICT sector in EU. The sector accounts for more than 5 percent of total GDP in EU
- R&D expenditure in the ICT sector and the number of patents exceed those of other industries. The ICT industry undertakes a considerable amount of foreign R&D investments
- Most of the R&D expenditure is in the ICT manufacturing segment, but semiconductor firms are the most R&D intensive and software firms have the highest R&D expenditure growth in the EU
- The ICT sector is heavily concentrated; large firms with more than 250 employees account for more than 60 percent of employment. ICT manufacturing is the most concentrated segment, with 80 percent of value-added being produced by large firms, which employed 75 percent of all those working in the industry; the ICT service industry is considerably less concentrated

Bulgaria sector snapshot

7.83. The ICT sector in Bulgaria has shown consistently excellent performance in all key aspects, and has strong potential for innovation and export-oriented growth. There has been constant growth from 2006 to 2010 in terms of revenue (14 percent) and profits (83 percent); and constant growth of export of ICT goods and services (14 times) since 2005, reaching 2 billion in 2011 (47 percent of the total export of business services). \(^{138}\) The average value created per employee was BGN45,700 in 2010, which is three times higher than the national all industries average (BGN16,800 per capita). The ICT sector also has the

\(^{137}\) Analysis of the Regional Context and Potential for Innovation in Selected Industries” World Bank (2012); Invest Bulgaria Agency, A.T. Kearney’s FDI Strategic Analysis, January 2011
\(^{138}\) Broadband Quality Score 2009 (BQS); Invest Bulgaria Factsheets, InvestBulgaria Agency, 2011
greatest number of registered patents (90 percent of all Bulgarian patents for the period of 2001-2010); and the greatest number of R&D projects under the Seventh Framework Programme (FP7)

7.84. Bulgaria’s ICT sector is still far behind that of other EU countries, including Hungary and Slovakia. It accounts for only about 5 percent of GDP, and does not attract the level of FDI as Romania and the Czech Republic. For ICT to become a leading driver of growth, a substantial change in policies and targeted support for the sector are necessary.

7.85. ICT companies in Bulgaria are of varied size and origin. Many of the top multinational ICT companies operate successfully in the country, where most have R&D or business process outsourcing (BPO) centers. There are also a large number of local SMEs, many of which have made a significant contribution to the sector and could be considered as a successful story and “good practice”. ICT infrastructure, including high-speed broadband, is relatively well-developed. Sofia ranks 11th in the world for its quality of internet connection and 6th out of European cities. Bulgaria is also accelerating development of its e-Government initiative, with more than 10 currently implemented projects in the e-Government area, aiming to catch up to the EU leaders.

7.86. Currently the industry is equally separated between the three key sub-segments in terms of employment, but telecommunications contribute for 73 percent of the revenues. The remaining two key sub-segments - computer programming, consultancy and information service activities, represent respectively 14 percent and 6 percent of the sector revenue.

Table 7.19: Top 20 growing companies in the ICT sector (2010-2011)

<table>
<thead>
<tr>
<th>Company and location</th>
<th>Income growth 2011/2010 (in %)</th>
<th>Income 2011 (000, BGN)</th>
<th>Income 2010 (000, BGN)</th>
<th>Net profit 2011 (000, BGN)</th>
<th>Number of employees 2011</th>
<th>Number of employees 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 3DC (Sofia)</td>
<td>181.00</td>
<td>2 085</td>
<td>742</td>
<td>308</td>
<td>22</td>
<td>8</td>
</tr>
<tr>
<td>2 Adastra Bulgaria (Sofia)</td>
<td>65.29</td>
<td>6 990</td>
<td>4 229</td>
<td>2 087</td>
<td>107</td>
<td>83</td>
</tr>
<tr>
<td>3 Chaos Software (Sofia)</td>
<td>58.91</td>
<td>12 317</td>
<td>7 751</td>
<td>5 078</td>
<td>76</td>
<td>62</td>
</tr>
<tr>
<td>4 ICGEN corporation (Sofia)</td>
<td>44.15</td>
<td>4 571</td>
<td>3 171</td>
<td>22</td>
<td>23</td>
<td>31</td>
</tr>
<tr>
<td>5 Arbutus 72 (Razgrad)</td>
<td>42.73</td>
<td>4 887</td>
<td>3 424</td>
<td>3 365</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>6 Bravo Investments (Sofia)</td>
<td>32.64</td>
<td>3 832</td>
<td>2 889</td>
<td>718</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>7 CAPK Progress (Sofia)</td>
<td>32.07</td>
<td>37 829</td>
<td>28 644</td>
<td>440</td>
<td>40</td>
<td>37</td>
</tr>
<tr>
<td>8 Infragistics Bulgaria (Sofia)</td>
<td>31.07</td>
<td>4 653</td>
<td>3 550</td>
<td>157</td>
<td>100</td>
<td>75</td>
</tr>
<tr>
<td>9 Intelligent Systems Bulgaria (Sofia)</td>
<td>21.83</td>
<td>4 459</td>
<td>3 660</td>
<td>396</td>
<td>63</td>
<td>55</td>
</tr>
<tr>
<td>10 Musala soft (Sofia)</td>
<td>21.37</td>
<td>10 961</td>
<td>9 031</td>
<td>1 368</td>
<td>201</td>
<td>184</td>
</tr>
<tr>
<td>11 Software AG development center Bulgaria (Sofia)</td>
<td>20.19</td>
<td>6 566</td>
<td>5 463</td>
<td>351</td>
<td>94</td>
<td>85</td>
</tr>
<tr>
<td>12 Acsway Bulgaria (Sofia)</td>
<td>18.27</td>
<td>11 302</td>
<td>9 556</td>
<td>1362</td>
<td>168</td>
<td>157</td>
</tr>
<tr>
<td>13 Inter Consult Bulgaria (Sofia)</td>
<td>17.56</td>
<td>5 196</td>
<td>4 397</td>
<td>744</td>
<td>97</td>
<td>80</td>
</tr>
<tr>
<td>14 Nemethcek (Sofia)</td>
<td>15.98</td>
<td>6 460</td>
<td>5 570</td>
<td>561</td>
<td>114</td>
<td>104</td>
</tr>
</tbody>
</table>
Key challenges in the sector\textsuperscript{139}

7.87. Lack of focused government support. The sector is not supported by the proper instruments, clear and fair rules for doing business, or efforts to reduce the administrative burden. There is also a lack of public financing for R&D, technology transfer support, and support for the commercialization of innovative ideas. Instability, corruption, crime, and informality are ranked among the top constrains for IT experts according to the World Bank Survey of Administrative and Regulatory Costs in Bulgaria (2009).\textsuperscript{140}

7.88. The greatest barrier to further sector development is the human capital shortage. Bulgaria ranks last in Europe in preparedness of its human capital for living and working in the Knowledge Economy (INSEAD eLab 2010).\textsuperscript{141} The sector lacks experts, and despite the large number of students with an ICT diploma (around 3000 per year), the quality of ICT education is deteriorating in most universities. As a result, the cost of expert advice has persistently gone up.\textsuperscript{142} Apart from the increased number of experts needed, the requirements for their competences are changing from technical knowledge and skills to key social skills and an attitude of innovation.

7.89. Payments to experts working on international assignments (for example, under FP7 programs) are significantly lower (up to 10 times lower) than in Western Europe, as they are calculated based on the local average salary.

Box 7.8: Bulgarian business management solutions to the global market - Orak Engineering, Ltd. - Plovdiv

**History and Development**

ORAK Engineering Ltd. (Orak) was established in 1996 as an independent software consulting company with the focus on developing, implementing and supporting business management solutions for Retail, Hospitality and Commerce. Orak was founded by Krasimir Stoyanov, at that time 24 years old, who was back then a software

\begin{footnotesize}
\textsuperscript{139} Interviews with companies and two focus groups with the ICT industry in Sofia (23 October 2012) and Plovdiv (20 November 2012), as well as participation in workshop in Hissarya on November 9-10, 2012 helped consolidate opinion about the challenges and opportunities for the ICT industry.


\textsuperscript{141} "Who cares? Who dares?" report, INSEAD eLab team, led by Bruno Lanvin and Nils Fonstad, 2010.

\textsuperscript{142} Average salaries in the sector are significantly higher than in other industries.
\end{footnotesize}
engineer with a diploma from a Plovdiv University-Aberdeen University partnership. Back in 1996 together with a couple of friends, he identified a market niche for a retail and management software solution for the commercial and hospitality business in Bulgaria. Krasimir convinced a local sugar manufacturer that he could provide the solution for their problems in three months’ time. He initiated the architecture, design and coding of the first version of what was later evolved to be the award winning Business Software Platform R5.

Until 2000, ORAK has successfully implemented a dozen of corporate solutions, including Alexandra Video Distribution and M-tel call center, and 30 to 40 smaller ones, diversified in restaurant, supermarket, oil and gas retail and hotel companies, thus building on the business expertise and insights into the market requirements.

In 2001, ORAK consisted of only four people in Plovdiv (second biggest city in Bulgaria) and a representative in Sofia – three developers and two consultants. The company’s target back then was to acquire enterprise projects and set up product management and implementation processes, together with User Training and Company Knowledge Certification programs. This was a turning point in the development of the company as it created a solid ground for future growth both as a market and corporate structure. Since then, ORAK managed to double its turnover in five consecutive years, dramatically increase its customers’ base, winning key account customers like Adidas, International Airport in Bucharest, large distribution companies, four and five star hotel chains. The employees’ base increased to 35 people in five offices in Bulgaria – Sofia, Plovdiv, Varna, Burgas and Stara Zagora. ORAK opened representative offices in Romania, Serbia, Macedonia and Turkey.

In 2007, the company created new business framework ORAK R6 from scratch based on the latest technology developments with the cloud services at its core. It is adaptive to solutions in the property management, beer processing & manufacturing, mobile commerce, among others fields. During that time the company created ORAK Global Marketing and Support Infrastructure including Moscow in Russia, Dubai in the Middle East, Plovdiv in the EU and Phoenix in the USA. Since then, ORAK maintains an average revenue growth of 20 percent per year. At present, ORAK is specialized in providing enterprise and retail scale projects solutions, managed in different company divisions. In fact, ORAK is a global player in the mid-size segment for enterprise solutions, partnering with major ERP providers (SAP, Microsoft, Oracle) extending the reach of their customers, through specialized vertical solution.

Awards

ORAK solutions were recognized with gold medals from the International Plovdiv Fair and CeBIT Istanbul Diploma. In fact, solutions created by ORAK R6 innovative technology have been awarded with nine gold medals from international fairs, which brings ORAK to new level of global business on the cloud. ORAK is a regular visitor of CeBIT Hanover, which is the largest exhibition of IT solutions. ORAK is a regular visitor also in CeBIT – Istanbul, TechWave – Las Vegas, Petroleum – Istanbul, World trade-Moscow, and Gitex – Dubai and it always comes back to Bulgaria with prestigious awards from these events. Finally, the company is well recognized in Bulgaria as well. Three years in a row ORAK was awarded “Most Innovative Company” by ARC Fund, Enterprise Europe Network, Ministry of Economy and Energy, and the World Bank.

Key Products, Markets and Buyers

The Riscont business takes 32 percent of total ORAK’s market, while POS comes second with 27 percent share and the Hotel Business represents the third most important buyer with its 17 percent share. The company operates on a license business mode, which creates about 50 percent of company’s turnover in 2011. Supporting contracts are the second important pie of the turnover with 34 percent share, while consulting services form about 10 percent share. Buyers are mainly attracted through direct sales activities, referral sales, marketing and product campaigns, exhibitions, technology and business partners’ sales channels. Global Partners are leading companies,
like Microsoft, SAP and Sybase.

**Key Innovative Products**

**ORAK R6 PMS** – Property Management Solution is an On-line platform for an Enterprise property management. It took one and half years from the idea inception to the release of the first version of the product. The initial investment is close to EUR100 thousand and it was funded through internal investment (80 percent) and customers (20 percent). The company continues to invest in the product and it is currently negotiating a major business and technological partnership with a local Telecom provider to market the PMS solution to other key clients.

**Android POSR6** is a mobile retail solution has been designed and developed for management of restaurants, retail shops, distribution centers and warehouses based on Google’s leading mobile operation system. The Product is solving the issues of mobility, flexibility and interconnectivity with social and corporate networks, thus providing value to operations and management. The investment took EUR60 thousand and one year of dedicated time.

**Government and Business Associations Support**

ORAK has received funding from Human Resource Development Operational Programme in the amount of EUR75 thousand (for two grants) and from Operational Programme "Development of the Competitiveness of the Bulgarian Economy" at the amount of EUR300 thousand. The support is for active corporate program for soft skills development in ORAK teams, as well as an investment aid for transferring ORAK’s product portfolio into the global cloud environment. Moreover, ORAK is often invited in international promotions of the Bulgarian software potential. As a result, the company has been actively supported by national export-oriented programs – company representatives have taken part in almost all events, organized by the government in the last decade. This includes participation in events and international exhibitions, as already mentioned. The company has also taken part in official visits abroad of the Prime Minister and President of Bulgaria, which have been beneficial in terms of setting up new contacts and development of potential markets. As far as business associations are concerned, ORAK co-founder is an active Board member of BASSCOM, which is an important player in the dialogue with the government. ORAK considers the business environment rather friendly, as regulations are not so restrictive.

**Regional development and specialization**

7.90. The sector consists of companies of different sizes and specializations. Large companies account for one-third of employment. Sofia is the undisputed hub of the ICT sector, with more than 85 percent of employees. Other regions that specialize in ICT are Plovdiv, Ruse, Varna, and Burgas.

7.91. Employment is equally distributed among the three ICT subsectors, but telecom contributes 73 percent of revenues.
Table 7.20: Bulgarian ICT Sector development

<table>
<thead>
<tr>
<th>Sub-segment</th>
<th>Revenue (000, BGN)</th>
<th>Employees</th>
<th>Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telecommunication</td>
<td>1446569</td>
<td>11662</td>
<td>104</td>
</tr>
<tr>
<td>Computer programming, consultancy and related activities</td>
<td>316087</td>
<td>10186</td>
<td>1286</td>
</tr>
<tr>
<td>Information service activities, incl.</td>
<td>124817</td>
<td>8460</td>
<td>1299</td>
</tr>
<tr>
<td>Other software publishing</td>
<td>101179</td>
<td>3114</td>
<td>160</td>
</tr>
<tr>
<td>Publishing of computer games</td>
<td>2847</td>
<td>297</td>
<td>4</td>
</tr>
</tbody>
</table>


7.92. Strong concentration in the sector. The eight companies grossing the highest-revenue are in the telecom activities segment, and generate more than 50 percent of all ICT revenues. Mobiltel, Cosmo Bulgaria Mobile, and BTC are the three main players, with 28 percent, 20 percent, and 6 percent of revenues. Mobiltel generates 43 percent of all revenues in the telecom subsector, followed by Cosmo Bulgaria Mobile with 31 percent. Many of the market leaders in ICT, especially in the software subsector are multinational companies, including Oracle, SAP, IBM, and HP.

7.93. The BPO segment is very well developed, due in large part to the presence of the IT giants HP and IBM. Hewlett Packard Global Delivery Business Center, the market leader in this segment, generates 2.14 percent of all ICT revenue and more than 36 percent of information services revenue, by servicing HP EMEA region. However, local companies are increasingly penetrating the global markets in the highest value added market segments reserved for global innovation leaders (see Box 7.9).

Box 7.9: From a Small Joint Venture to global innovative problem-solver – InterConsult Bulgaria

History and Development

InterConsult Bulgaria (ICB) was founded in 1996 as a Bulgarian-Norwegian company and started operations in Sofia with three employees. The company experienced a turning point in 2005 when it started work with several large buyers from Norway, UK, Germany, and USA. ICB managed to implement latest technologies and achieve exceptional results for its customers by developing world-class products. The company increased substantially its revenue to EUR600,000, while ICB employees reached 50 – most of them computer engineers. Today, ICB is a privately-owned Bulgarian company with 110 employees and annual turnover of ca. EUR3 million.

Awards

In 2008, ICB developed its first solution after winning a tender for the newly established Cash Service Company in Bulgaria which became a nation-wide project and later won the prize 2009 Corporate IT project awarded by Computerworld Magazine. In 2009, ICB was listed among Deloitte Technology Fast 500 companies in the EMEA region. De facto, starting from a small joint venture in 1996 for IT outsourcing purposes, today ICB is an innovative problem-solver, using latest technologies to provide best of class IT solutions to its global customers. ICB has long-term cooperation with its customers, built on trust. Moreover, the Bulgarian company has earned the
ICB is a Microsoft Gold Certified partner with competences in ISV, Application Integration, Content Management and Software Development. Since 1999, ICB has been certified under the ISO 9001:2008 standard for software development and business process modeling services. All ICB developers and quality assurance specialists (about 90 percent of all staff) are certified by leading IT providers like Microsoft to ensure highest quality of services provided. In addition to the certificates awarded (see above), ICB has been recently awarded with the European IT Excellence Award 2010 (winner in 2 categories - Solution Provider and Sub Category: Vertical Market). The company received also a bronze medal for the innovative engineering solution Engi-Tools at the 39th International Exhibition of Inventions in Geneva.

Key products, markets and buyers

Key Products/Services are software development services, IT consulting services as well as solutions development like Safe Family (integrated solutions for cash handling operations in Cash Service Centers, Banks and large Retailers). Key Markets for ICB are Norway (over 70 percent of the turnover), USA, UK, Germany and Bulgaria. Key buyers for ICB are Cash Service Company in Bulgaria and the largest banks in Bulgaria. Earlier versions of these solutions were implemented in lead financial institutions in Norway.

Key innovative products

AgileMode is a unique solution which turns the described business processes of an organization into an executable portal automatically without further development. The portal is a company-wide solution that enables employees to execute the tasks they are responsible for fast and easy, including documents approval, knowledge management etc. For the product development, ICB dedicated R&D budget of almost EUR500,000 and more than two years of time. Key client for AgileMode are world famous companies, like Kongsberg Maritime (KM)-Norway, which is a leading company with over 5,000 employees and 25 offices worldwide and production facilities in Norway, Singapore and the USA, providing products and systems for dynamic positioning, navigation and automation to merchant vessels and offshore installations. KM reports that thanks to ICB solutions, they have managed to increase 30 times their productivity for product documentation generations, they report radical decrease in sales period and millions in savings each year. Other innovative solution is Engi-Tools. This is a tailor-made system for Kongsberg Maritime (KM) that integrates several systems and generates automatically complex technical, sales and user documentation. Documents creation time is cut from 60 days to two business days. Annually, this solution saves millions for the customer. During one of the biggest exhibition of the industry - CeBit 2011 in Hannover, Engi-Tools was awarded with the prestigious Gold Seal of E-excellence.

Government and Business Associations Support

ICB has participated in a couple of international visits of the President of Bulgaria and the Minister of Economy and Energy, where some interesting contacts with international companies were established. However, ICB has never been a beneficiary of national instruments or government programs for status of ‘Preferred Partner’ to major buyers.
development of innovative activities. The Bulgarian SME Promotion Agency has been partly supporter of ICB by organizing national stand at key IT exhibitions and by providing exhibition space for IT companies, like ICB. As far as membership in Business Associations is concerned, ICB is a member of BASSCOM and BAIT -the largest IT associations in Bulgaria. ICB receives regularly results from market research, which are helpful. Additionally, business associations provide information support about strategic national and international events, but what is more important they represent the single voice of the sector when facing the government in terms of new regulations or needs to improve the business environment. In fact, ICB reports that the national business environment is not a significant factor for the company operation given that only 10 per cent of ICB revenues are generated in Bulgaria. The highest impact is the lack of IT specialists that ICB could hire to grow its business. ICB, as many other companies in the ICT industry, is keen on working with Universities to improve their IT programs so they produce young generation of IT specialists that respond to business needs.

**Sector ecosystem**

7.94. The fields with highest technological innovation intensity in Bulgaria’s ICT sector, based on the number of patents issued: 143:

- multicomputer data transferring
- measuring, calibrating, or testing
- database and file management or data structures
- software development, installation, and management
- virtual machine task or process
- database and file management or data structures
- interprogram communication or interprocess communication (IPC)
- Processing architectures and instruction processing
- Pulse or digital communications
- Speech signal processing, linguistics, language translation, and audio compression/decompression
- Image analysis
- Information security
- Memory
- Radio wave antennas
- Artificial intelligence
- Recording, communication, or information retrieval equipment.

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143 List of Bulgarian international patents, Bulgarian Patent Bureau , 2011

7.95. There is still a low level of cooperation between business and R&D institutions, including universities. Most R&D activities are concentrated in large companies, which have separate R&D units. Some international companies (VMware, SAP) have substantial local offices dedicated solely to R&D activities. The well-educated workforce with substantial language skills combined with relatively low labor costs and cultural similarities with other EU countries are the major factors for attracting foreign investors in that sector. Higher education is not able to meet the industry’s human capital requirements. One reason is the brain drain to other countries; another is the lack of focus on ICT and business and social skills in secondary education.

**Sector opportunities and scenarios**

7.96. The ICT sector has the highest innovation potential of all sectors of the Bulgarian economy, in both business process innovation and innovative products and services. Companies operating in this sector are part of the small group of global innovation leaders and successfully export products and services in the highest value-added segments global ICT market. Software, Hardware, Telecommunication and IT services together account for almost 70 percent of Bulgaria’s international patents, and the number of patents has increased significantly since 2004. In 2012, 18 of the 23 patents issued were related to ICT. Data processing, digital processing, software development, digital communication, and electrical computers have the highest total number of patents. Apart from excellent potential for sector growth, ICT has the potential to drive the innovation-based growth of the Bulgarian economy as a whole.

7.97. Bulgaria is recognized as a good destination for outsourcing and off-shoring. Key ICT players are already successfully operating in Bulgaria shared (or managed) services centers. This created significant opportunities for human capital formation and building much need combination of technical and business skills capacities

7.98. Harnessing the knowledge, skills and business networks of Bulgarian ICT experts living abroad would help generate additional opportunities for sector development in higher value added segments, generate FDI and address some concern associated with the shortage of skilled workforce.

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144 Bulgaria has been ranked 9th in A.T. Kearney’s annual ranking for 2009 of the most attractive locations for off-shoring of service activities such as IT, business processes and call centers. Bulgaria also placed 13th in the Economist Intelligence Unit’s global ranking of best outsourcing destinations for 2010.
ICT was selected by the European Commission as a 2nd thematic objective (and therefore investment priority) within the Smart Growth pillar for the Europe 2020 strategy. The ICT ecosystem is a quintessential element of economy’s competitiveness and innovation, and as seen from the figure, there’s a positive correlation between the broadband penetration and the latest World Economic Forum Competitiveness Index. ICT was coined as a ‘general-purpose technology’ that (i) spawns innovation and R&D introducing new products, services or processes, (ii) pervades to all economic sectors, (iii) improves over time and decreases the costs for users [1]. ICT has a unique role in the diffusion of knowledge and creation of innovation networks.

ICT ecosystem is integral for knowledge economy, as it induces economic ripple effects igniting innovation and moving the technological frontier across the firm-, industry- and economy levels. However Bulgarian economy needs to establish a system to properly capture economic gains from the ICT-enabled business innovations. The Bulgarian ICT sector should serve a catalyst for innovation activity and research outputs. It can serve as a way to upgrade production processes (digital modelling, simulation and visualization, big data analytics, social and collaborative technologies, and just-in-time supply).


**SWOT ANALYSIS**

**Table 7.21: SWOT Analysis for the Bulgarian ICT**

<table>
<thead>
<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- High-value per employee outperforming most of the sectors</td>
<td>- Below average R&amp;D spending &amp; ineffective spending of funds</td>
</tr>
<tr>
<td>- Good R&amp;D potential, taking into account ICT patents and ICT projects under (FP7)</td>
<td>- Inefficient system for the protection of intellectual property rights, specifically service innovation and business process innovations</td>
</tr>
<tr>
<td>- Active presence of top-multinational ICT companies, with local R&amp;D and BPO centers</td>
<td>- Shortage of labor combining technical knowledge with business and soft skill sets</td>
</tr>
<tr>
<td>- Rapidly increasing contributions of local companies in the highest value added market segments</td>
<td>- Increasing brain drain due to relatively low salaries (from a global perspective)</td>
</tr>
<tr>
<td>- Well-developed ICT infrastructure including high-speed broadband.</td>
<td></td>
</tr>
</tbody>
</table>
Opportunities
- Small but growing domestic market, access to and presence in global markets
- Upcoming e-Government initiative will spur further innovation and growth
- Opportunity for technological absorption through FDI
- Leveraging diaspora knowledge and networks can create opportunities for higher value added further development and global capacity
- BPO, R&D and data centers growth opportunities are significant. ICT cluster could further develop outside Sofia.
- There are key areas where ICT capabilities in the country are highly competitive on a global level (semantics etc.) and could be a basis for “Centers of Excellence” development.

Threats
- Dependence on foreign companies for patent development

G. Cultural and Creative Industries (CCIs)

General characteristics of the sector:

- Highly concentrated in Sofia with insignificant degree regional clustering in Plovdiv, Burgas, Stara Zagora and Russe.
- Very high innovation intensity (emphasis on service innovation)
- Low R&D intensity, with high-potential for spill-over in technology sectors

Key sector characteristics and recent developments:\textsuperscript{145}

- In 2009, creative and cultural industries (CCI) firms employed a total of 6.4 million persons in 30 European countries.
- Regions with high concentrations of CCI have Europe’s highest prosperity levels.
- CCI are concentrated in large urban areas and capital city regions, but some city regions do better than others. The super clusters London and Paris stand out, followed by Milan, Madrid, Barcelona and Rome.
- CCI are significant generators of intellectual property (IP), in particular copyrights.

• Regions strong in CCI also tend to have higher levels of patenting.
• Among the regions of Europe which rank among the top 25 in CCI employment are Amsterdam, Berlin, Frankfurt, Darmstadt, Brighton, Budapest, The Hague, Lisbon, Inner London, Oxford and Stockholm.
• As a share, CCI account for the largest share of the regional labour market in Stockholm, Prague, 
• The highest annual CCI employment growth rates in the period 2003-2009 are found in Cyprus (25.79%), Slovakia (25.60%), Estonia (11.48%) and Latvia (9.78%)

7.99. CCIIs produce many different types of positive innovation spill-overs on the economy and society as a whole, including: inspiring creative and innovative entrepreneurship, nurturing behavioral shifts in corporations, helping social regeneration of deprived areas, introducing innovative forms of teaching, using culture and creativity as management tools for improving relations in the workspace, etc. CCIs also are credited with promoting innovation in other sectors of the economy through their “transformative power.” Innovation today follows the path of CCIs who are behind demand-driven markets, shaping consumers’ desires, aesthetic values and preferences. Traditionally CCIs have set the stage for technological innovation – serving as the instigators of innovative technical means to deliver the cultural or creative content, as well as the pioneers in using technological innovations.

7.100. Bulgaria Sector Development Snapshot:

• CCI are dominated by small and micro enterprises with 10 employees or less, as well as partnerships of 2-4 free-lance practitioners. Large businesses are present in the printing, media and software development industries.
• CCI have a significant contribution to GDP: in 2008 gross value added was 5.54% (BGN 3,147 billion) and CCI accounted for 4.93% of employed in the country (over 188 thousand)
• Average productivity per employee is 30% higher than the national average
• In the period 2003-2008 gross value added in CCI has grown by 100% compared to average growth of 40% for the economy as a whole
• During the period 2008-2010, CCI business, despite the crisis, retained personnel
• Since 2010 there is growth in employment in the gaming software, film and graphic design industries
• CCI businesses reinvest the majority of generated profits in new innovative product development, service innovation and staff skill and capacity building

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147 Unearthing data on Bulgaria’s CCI businesses is a very complex task as the National Statistical Institute does not collect and analyze data on the CCI under a separate statistical category
Bulgaria has highly-qualified personnel and low production costs (wage costs) compared to other EU countries, which makes it attractive destination for services and production outsourcing.

Highly-competitive environment, strong presence of international players, and excellent linkages with partners abroad.

Very high level of integration in international networks with highest level of internationalization in the gaming software, film, broadcast media and printing industries.

While there are positive export trends in the gaming software segment, overall Bulgarian CCI are net importers of foreign creative products and foreign IP.

More than half of the CCI businesses are concentrated in Sofia, the rest in large cities such as Plovdiv, Varna, Burgas, Stara Zagora and Ruse. There are several small clusters (mostly cultural heritage and crafts) in smaller municipalities.

Clustering is predominantly small scale (up to 10 partners).

7.101. CCIs are driven by user-interaction and therefore contribute to the user-centered innovation responding to user/consumer tastes rather than to market trends. An example that illustrates this phenomenon is that more often architects, rather than construction engineers or material scientists, are the driving force behind the development of new, lighter and energy saving building materials in pursuit to design innovative buildings, take advantage of natural light, incorporate living ecosystems, nurture different types of human interaction, highlight the need for new materials and technologies. Such user-centered, design-inspired innovation allows designers to contribute to the development of products and services.

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148 All data is from 2008. Source: “The Entrepreneurial Dimension of the Cultural and Creative Industries” Utrecht School of Arts, K2M and Eurokleis (2010) and Author’s calculations.
7.102. CCI businesses are the pioneers in commercializing innovative products and solutions. Because of the constantly changing dynamic between audience and content creator CCI foster exploratory environments that unlock innovation potential and are one of the core determinants of innovative spillovers.

**Box 7.11: Treasure Ltd., Varna – Bridging Bulgarian History, Cultural Heritage and Ancient Arts and Crafts Methods**

**History and Development**

Treasure Ltd. ([www.treasure.bg](http://www.treasure.bg)), established in 2011, creates artifacts, replicas of ancient treasures, paintings and unique souvenirs based on themes from ancient Bulgarian and Thracian history. The company was co-founded by Prof. Nikolai Ninov, who in the last decade, in addition to being engaged in academic teaching and research, is also an acclaimed sculptor with art works exhibited in the Bulgarian National Art Gallery, Bulgarian Art Union, and independent galleries throughout the country; and prized by private collectors in Bulgaria and from abroad. The other co-founder is Ivelin Michailov, a business visionary with significant background in the insurance sector.

Treasure Ltd. started with one employee in an office in Varna - Bulgaria’s sea capital. The business model at the outset was to focus on luxury Bulgarian goods, with international tourists as the primary targeted customer segment. After acquiring the rights to produce replicas of ancient Thracian and proto-Bulgarian treasures from various museums, the company crafted replicas of these treasures, as well 30 exhibition hand-crafted window panels that were displayed in luxury hotels throughout the country. Next to crafting genuine replicas of ancient treasures, the company is also developing innovative cultural products based on themes from ancient Bulgarian and Thracian history. Both lines of cultural products intertwine history, cultural heritage and artistic values and enrich the tourist experience of foreign visitors exploring the history of the Bulgarian lands.

To date the most successful handcrafted product of Treasure is a replica of the oldest man-processed gold in the world (6400-6100 BC), discovered in 1972 in Varna. The product in addition to being a showcase of ancient craft methods and artistic expression also has significant symbolic values as it establishes the connection between Europe’s contemporary civilization Varna’s cultural heritage – some legends even link Varna’s culture to Noah’s Ark and ancient Atlantis.

Two years after the launching Treasure Ltd., the company has crafted 70 exhibition luxurious window panels and has served over 100 corporate clients. Currently their products are well-received for their value in celebrating Bulgaria’s cultural heritage, and the business of the company shifted from targeting international tourists vacationing in Bulgaria to crafting high-quality luxury business presents and souvenirs targeting Bulgarian customers and their business partners from abroad. The company is growing and steadily expanding their customer base: now in addition to its Varna headquarters it has a representative office in Sofia and over 10 employees.
Key products, markets and buyers

When crafting an artifact, Treasure Ltd. searches for in-depth information from a historical and cultural point of view. For example, the hand-crafted series “Great Bulgarian Kings”, bronze sculptures of about 30 sm in height high; were created with under the guidance of art historians and each of the 10 artifacts is deemed to genuinely represent authentic historical themes.

Another product is a unique business card that is hand-minted in the form of an ancient coin with the face of the possessor on one side and the business contacts on the other side of the coin. The company still focuses on the Bulgarian market, but it is exploring opportunities for expanding the market abroad. Corporate clients are the backbone of the company but other client segments, such as universities, municipalities, and organizers of special events are also customers of Treasure’s products.

Awards

The company has not been recognized yet with an award. Its products are often used crafted as awards: the Varna University of Economics recently awarded European Commissioner Kristalina Georgieva with a Khan Asparuh Eagle, a bronze silver-plated sculpture produced by Treasure.

Government and Business Associations Support

Treasure Ltd. has successfully developed a market niche on Bulgaria’s market for cultural heritage products. It is an innovation trend-setter, creating products that intertwine historic themes and ancient arts and crafts methods and its products are certified for authenticity of historic themes and ancient art forms. The company is not part of any business association and has not received any support of business development assistance from the government.

Key challenges in the cultural and creative industries sector

7.103. The core challenge in developing the sector and unleashing its transformative power to foster innovation spillovers in other sectors is attracting and retaining the creative talent, such as architects, designers, advertising creatives, game developers, etc., as remuneration for “creatives” in Bulgaria is not competitive. Similarly to highly-qualified researchers and skilled software engineers, creative talent is highly mobile and follows higher remuneration opportunities abroad and contributes to the “brain drain.”
7.104. Since the onset of the financial crisis, businesses in the CCI sector have experienced financial constraints retaining creative personnel and, as a result, quality of the creative component of CCI’s products and services significantly decreased, contributing to a downward sliding demand for creative products. The financial “crunch” resulted in diminishing the “creative component” and overemphasizing the importance of the technical delivery mechanisms for CCI products and services. While CCI products or services include a component of artistic expression, these products and services emerge through the mode of the implementation of this “creative component,” - namely its technical execution. For example, the creative, artistic expression captured in architectural drawings emerges as a result of construction works; an actor’s performance is delivered by technical means such as film or live streaming. As the market pushes prices for CCI products and services down, expenses for the “creative component” are most often cut as it is less feasible to reduce costs associated with technical implementation i.e., construction costs, cost of film, cameras etc.

7.105. Cutting costs dedicated to the “creative component” reinforces the use of traditional, established technical models and solutions. An example from architecture segment: cutting the cost of a construction project would typically force architects to develop a more commonplace architectural designs, use older, tried and tested materials and solutions as these are cheaper. In this respect underpricing the “creative component” compromises the use of more innovative materials or solutions as these are typically more expensive. This in turn decreases the CCI’s ability to define a creative environment that could inspire innovation in other sectors i.e., its take advantage of its transformative power.

7.106. A related concern is that the “creative component”, be it in publishing, advertising, film, etc., is a core driver of service innovation. Exploring new and innovative technical means of content delivery, new service and product marketing models etc., promotes innovation. The creative industries on one hand form the “creative environment” that spurs innovation, on the other are the first users of such innovation as creativity and innovation are intricately interlinked, feeding off each other. For example: digitalization allows advertisers to use new marketing platforms, but fragment audiences across multiple media (internet, mobile apps, print, TV etc.), which inspired new business models and innovation in services to serve the market scattered across multiple media.

7.107. CCI in Bulgaria are severely constrained in accessing the funds they need to finance their activities, both in terms of credit and equity. Considering that most CCI businesses in Bulgaria are micro enterprises or small groups of free-lance practitioners, they do not present the critical mass needed so banks find CCIs commercially interesting enough to analyze CCI projects or develop expertise to understand the special business models of CCIs. While this is a common challenge for Bulgarian micro enterprises and SMEs, the lack of access to financing is significantly worse for CCI businesses as they
rely on intangible assets\textsuperscript{149} which are often not accepted as collateral by banks; also since CCI products are generally not mass-produced banks typically view them as unique prototypes with uncertain market value.

7.108. Establishing a fund for CCI in Bulgaria to subsidize the development of the “creative component” would offer the much needed support and alleviate the access to finance constraints that Bulgarian CCI businesses are facing. Such fund would provide grants that essentially would subsidize the costs associated with creative talent and costs of developing the “creative component” of CCI products/services. By way of example: in construction grants would subsidize the cost of architectural design works, including designing a building that takes advantage of latest resource-saving materials, most energy efficient technologies; in film, theater opera – grants would subsidize the cost of “talent” actors, singers, screen writers, musicians, set designers, etc.

Box 7.12: CCI public support mechanisms in the EU

Austria - departure, the Creative Agency of the City of Vienna provides non-refundable grants to CCI businesses in the art market, architecture, audio-visual production, design, fashion, music, multimedia, and publishing industries. Its grants (EUR 20 000–200 000 per project over 3 years), to CCI businesses focused on developing and promoting new creative and innovative products, processes and services in the run-up to serial production, consulting services for projects allowing increased growth and the gain of knowledge, and CCI start-ups. The agency also promotes the cooperation between CCI businesses and traditional industries to strengthen competitive advantages on both sides.

Belgium - CultuurInvest is an investment fund that provides risk capital to CCI business in new media and computer games, audiovisual arts and digital design, music industry and concerts, design and designer fashion, printed media and graphic design, publishers and bookshops, performing arts, distribution within the visual arts, communication and advertising, architecture and cultural heritage industries. Through subordinated loans or minority capital participation the fund helps CCI businesses focus on commercial development and growth to access additional and diversified income resources and extra cash flow, as well as to pay back loans.

Belgium - St’Art Investment Fund for Cultural and Creative Industries contributes to the creation of CCI start-ups and the development of existing ones in undertaking new projects, creating new products and accessing new markets. The fund provides financing in the form of loans (EUR 50 000 minimum) and via equity participation investments. The fund also helps CCI businesses in interactions with banks and private investors and with public bodies and regional investment funds: St’Art does not replace other financial mechanisms and other public subsidies.

France - Institute for Film Financing and Cultural Industries is a lending institution that helps CCI sector businesses in obtaining bank financing and provides primary lending banks with comprehensive risk analyses on the CCI projects (particular focus on film and audiovisual arts). IFCIC typically guarantees 50 % of the loans so if a project fails, the primary lending bank’s losses are cut by half. All CCI product/project development stages are

\textsuperscript{149}A related concern in Bulgaria is the weak enforcement of IPR rules, which combined with the heavy reliance of CCIs on networks in high-innovation and high-risk environments discourages innovation.
Netherlands - Cultuur-Ondernemen is a foundation that supports and guides artists, CCI businesses and CCI organizations by providing coaching and mentoring, training and education, learning on-the-job, market development and networking, financial support, consulting, search for advisors and chairmen, research and information services. The foundation also gives loans to artists and CCI businesses at very low interest rates.

Northern Ireland (UK) - Creative Industries Innovation Fund (pilot in 2008, refocused in 2011) established by the Department of Culture, Arts & Leisure (DCAL), the government agency supporting the CCI in Northern Ireland, and administered by the Arts Council provides financial support to CCI businesses and sector development projects focusing on innovation in business; innovation through people; innovation through sector infrastructure and knowledge. Since 2011 the fund also provides funding for innovative development of commercially viable content, products, services and experiences capable of competing in global markets. Since 2011 the fund is also sponsored by Northern Ireland Screen - a government-backed agency for the film, television and digital content and by Digital Circle – an association of digital content companies in Northern Ireland which works to develop skills and investment.

Regional development and specialization

7.109. CCI present a set of different knowledge-based services with significant spill-over effect into other sectors of the economy: insufficient clustering and collaboration prevent building efficient networks through match-making, taking advantage of coaching and skill building across industries, promoting creative environment by using shared office space and shared business services, gaining “economies of scale” to succeed in the Bulgarian and EU markets.

7.110. CCI are heavily concentrated in Sofia, with some regional concentration predominantly in Plovdiv and Varna, less in Burgas, Stara Zagora and Russe. Co-location of CCI producers and services providers, educational and research institutions, financial institutions and government institutions – commonly recognized as a CCI clustering through Europe – is non-existent in Bulgaria. There is also a fairly low-level of networking between CCI businesses, academia, public bodies, companies and investors: most prevalent are positive examples of such networking in the cultural heritage, festivals and crafts industries.

7.111. There is a need for CCI clusters in Bulgaria because most businesses in the sector are micro-enterprises, and clustering would help them form of alliances on projects and to access new markets. Stronger clusters between enterprises would also increase opportunities for companies to do business. Establishing “creative incubators”, or “creative hubs” (similar to technology parks) bringing creative people together i.e., architects, advertising creatives, designers, games developers, screen-writers, etc., would help induce a creative environment that can spur innovation in other sectors of the economy.

7.112. Experience from other European countries shows that creative physical spaces (such as “creative incubators” or “creative hubs”), result in forming single-location clusters, as well as broad networks that lead to the exchange of knowledge and business. Most importantly, other countries’ experience in this area shows that such networks link partners based on creativity-driven innovation and promote regional growth and employment as well as provide a platform for increasing exports.
Box 7.13: Creative Incubators and Hubs

Estonia - Tallinn Creative Incubator and the Tartu Centre for Creative Industries. The Estonian national strategy for the use of Structural Funds 2007-2013 identified creative incubation as one of the key elements in fostering innovation and entrepreneurship and creative incubators were created by the local municipalities or educational institutions. The EU funding covers investment into infrastructure, equipment and part of the running costs for creative incubators. Successful examples include the Tallinn Creative Incubator and the Tartu Centre for Creative Industries, both operating since 2009. The Tallinn Creative Incubator (operated by the Tallinn’s Business Support and Credit Management Foundation) provides incubation services to more than 30 CCI start-ups active in jewelry design, glass arts, graphic design, photography, handicrafts, performing arts, fashion design, interior architecture and 3D/4D animation. Tartu Centre for Creative Industries (operated by the Tartu City Council) provides to CCI businesses in Tartu and South Estonia information and training services, legal and economic consulting for creative entrepreneurs, as well as business incubation (and pre-incubation) services.

Ireland - Temple Bar, today Dublin’s cultural quarter, was a manufacturing area dating back to the 10th century that was transformed during 1991-2001 into a modern quarter home to Dublin’s cultural organizations and CCI businesses. The over EUR 200m regeneration project was financed through a combination of funding from the European Union Structural Funds, the national budget and significant private sector investment. In addition to funding for physical redevelopment of the area, some of the public funding supported key projects, such as the Independent Cultural Entrepreneurs initiative which equipped young, emerging talent with the business skills required to achieve their potential and develop their creative businesses in a sustainable fashion.

Spain - The Art Factories initiative aims to increase Barcelona’s public venues for cultural creation in the different artistic fields: visual arts, music, dance, circus and other performing arts, by transforming some of the Barcelona’s vacant industrial buildings into spaces that generate culture – artistic creation factories – and hand them over to creative groups and associations. The long-term expected result is to stimulate and redistribute this creativity throughout the different neighborhoods where the old factories are located. It is a new way to provide energy and support to the CCI of Barcelona in the areas of training, creativity, innovative production and research.

Netherlands- Creative Factory, operating in Rotterdam since 2008, is an old grain silo located in a deprived area that was transformed into a creative business incubator housing CCI businesses and helping them grow faster through partnerships with businesses, educational institutions and governmental bodies. The Creative Factory serviced 74 CCI companies in 2011, who rent desks instead of square meters at a very low cost, subsidized by the financial contributions of the Creative Factory partners. No public subsidies are involved; the managing company is privately-owned and rents the building from the City of Rotterdam.

Sector ecosystem

7.113. CCI s are by nature inter-disciplinary, they combine culture on one hand and economy on the other. Arts and culture are often described as the core in a system where the CCI surround the core and the wider economy surrounds the CCI. Both profit-making CCI businesses with a cultural dimension and cultural activities without a direct commercial aim together convey the core creative and artistic

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150 “How to strategically use the EU support programs, including Structural Funds, to foster the potential of culture for local, regional and national development and the spill-over effects on the wider economy?” Policy Handbook developed by Working Group of Members states experts on cultural and creative industries April, 2012.

Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013", financed under Priority Axis 5 "Technical Assistance" of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
expression and provide a great potential for local, regional and national development and spill-over effects on the wider economy. Nurturing the optimal CCI-specific conditions, for example by developing a creative ecosystem in particular city or the region is important determinant in using CCI to implement smart specialization strategies.

Box 7.14: Spain: Action Plan to Promote Cultural and Creative Industries

In 2010, Spain developed an Action Plan to alleviate the effects of the international financial crisis on the CCI sector in terms of decreased employment and access to credit. The plan provides special treatment to more traditional CCI sectors such as performing arts, visual arts, cultural heritage, film, television, radio, music, books and newspapers, but places a special emphasis on supporting CCI sectors with strong potential for creativity-driven innovation, such as design, fashion, architecture, advertising, new media, video games and interactive arts. Under the plan over EUR 35m in associated funding is targeted promote creativity through training grants and awards for creativity in schools; support the digitization of content and development, consolidation and internationalization of cultural and creative industries through grants, guarantees for enterprises, loans, training of cultural entrepreneurs, grants for cultural activities and for the promotion of cultural tourism.

7.114. The public procurement market has increased in importance due to market shrinkage in the wake of the financial crisis. However, CCI businesses in Bulgaria access this market solely as means of supporting economic survival, as procurement agencies in Bulgaria award contacts to the lowest-priced bids (typically solutions with very low level of creativity and innovation intensity) that do not allow more expensive creative or innovative solutions to stand out.

7.115. Changes in the legal framework to promote “innovation-driven procurement” would allow evaluating procurement agencies to select the “most economically advantageous offer,” rather than automatically select the “lowest price offer” - in essence providing an opportunity to consider offers that are based on innovative (not standard) solutions, and more creative approaches. Typically these are more expensive that the “tried-and-tested” products/solutions that are based on “current standard” technologies – often outdated technologies. On the other hand, the more expensive offers, such based on innovative, untested technologies, or more creative products/solutions, are typically associated with lower long-term costs, are more sustainable in the long run, have greater level of customization, more intuitive, easier to use. In this context, a procurement system that does not give the “lowest priced bid” absolute priority, and gives a preference to the “most economically advantageous offers” (i.e. bids with long-term savings – typically based on innovative/creative solutions) would promote innovation, as well as provide procurement agencies with the latest or upcoming technologies, and solutions that are more intuitive, easier to use, more customizable.

152 “Promoting cultural and creative sectors for growth and jobs in the EU” COM (2012) 537
7.116. Another revision to current procurement practice to promote innovation-spill overs instigated by CCIs would be to mandate separate procurement calls for developing the “creative component” of a CCI product/service and for its technical implementation works. For example, separate calls for architectural design and construction works; separate procurement calls to develop the advertising concept and for content delivery method and media acquisition, etc. In general, lumping together the creative component and technical implementation works compromises the quality of the creative component and diminishes the possibility of taking advantage of the most innovative solutions and the ability of the CCI products/services to set the stage of a creative environment that spurs future innovation. Separating calls would remedy this trend.

Research and development

7.117. CCI sectors are have typically very low research and development intensity; however, CCI creative talent as well as the creative enterprises can significantly contribute to R&D efforts in traditional industries by helping overcome different type of challenges, including issues concerning innovative user-centered products, creative R&D methods, communication, human resource development, intercultural dialogue etc. Such interactions in Bulgaria are minimal and should be actively promoted. Experiences from other European countries show that the CCI sector can provide tangible results in other sector’s R&D efforts and successes.

7.118. Several EU-funded projects focus on developing linkages between CCIs and other businesses to provide “creative support” for R&D projects. For example the Kaleidoscope project in Finland is creating a cooperation and innovation network between CCIs and the maritime and metal industries, while the Kainuu region in Finland is concentrating on piloting new business models between CCIs, food processing and tourism. Manchester City implemented a Creative Credits voucher scheme to support innovation and growth within SMEs through knowledge transfer from creative businesses.

Box 7.15: Harnessing the CCI transformative power

Denmark - Centre for Culture and Experience Economy is an independent government-funded agency established to raise awareness among the general business community how to increase growth and innovation through experience-based business development, and to strengthen the CCI sector’s business understanding through strategic collaboration with the business world. Among other activities, CCEE supports entrepreneurial projects that strengthen collaboration and skill exchange between the CCI sector and the business community at large, promotes the culture and experience economy and strengthens collaboration between institutions and businesses, collects knowledge in Denmark and internationally, including knowledge from the ‘experience zones’, and disseminates it to the public sector, the cultural sector and to businesses, provides guidance and advice to businesses that want to work with experiences and creative skills, as well as to those in the cultural

sector that want to enter into collaboration with the business community.

**Latvia - Riga Film Fund** is a municipal fund for co-financing film projects with a budget over 700,000 Euro aimed at promoting Riga as a creative urban area, as well as to increase revenue of local businesses from foreign film productions. The fund provides a cash rebate of 15% of film related expenditures in Riga, including costs for transport, rental of premises and technical equipment, accommodation, public facilities, construction facilities, artistic and administrative work. The rebate is aimed specifically at attracting foreign film crews to live and work in Riga and has fuelled a boom in foreign productions. Since its establishment in 2010 the fund supported 12 foreign productions; by comparison, before establishing the Riga Film Fund, Latvia had 1-2 film productions per year.

**Portugal - ADDICT Creative Industries** is an agency dedicated to supporting CCI that is also a platform that, through the dissemination of knowledge, information, promotion and coordination of the CCI, contributes to the development of entrepreneurship and the creative economy. The agency also develops strategies and action plans (for approval by the management authority of the Portuguese operational program on competitiveness) on promoting competitiveness, technology hubs and clusters and acts as the aggregator and organizer of cross sectoral activities. The core focus of the agency is encouraging individual creativity; contributing to an economy based on talent and creativity by supporting entrepreneurial creativity; and promoting a critical mass of creativity in urban areas to make these more attractive to CCI businesses in order to help them retain their creative talent.

**Sweden - TILLT** is an internationally recognized best-practice example of successfully building creative alliances in the work place. It places artists and creatives in traditional business workspaces to help businesses harness the way of thinking specific to a given artist and unleash its creative potential in the workplace to be a catalyst for change. Artists and employers are matched to the unique experiences of the people involved, whereby TILLT acts as a process leader to create a buffer between the artist and the company allowing the artist to be provocative without the fear of provoking too much and ensure that limits of the organization are expanded at their own terms as well as that artistic expression and integrity is protected. The goal of the programs is to induce creative change, expressed in innovation, research, new models of communication and new approaches to the unknown, as well as in increasing the levels of productivity. Studies carried out by the Institute of Management Innovation and Technology in Gothenburg has shown that employee productivity increases and levels of sick leave decrease in participant companies. The studies have also shown increased creativity and innovation in organizational models, communication styles, and greater interest in accessing to new entrepreneurial arenas.

**Sector opportunities and scenarios**

7.119. Bulgaria has all the conditions necessary for creativity-driven innovation based on the distributive effects of a dynamic and growing CCI sector. The country does not lack in creativity or spirit of innovation to fuel future growth. What is missing, however, are the much needed interactions between creative and talented people and forward-looking researchers and inventors involved in breakthrough R&D projects. Increasing such interactions would help foster technology innovation and developing user-centered products/services that draw upon Bulgaria’s unique cultural background.

7.120. Major factors that could positively affect the growth of Bulgaria’s CCI sector and its transformative power to bring about innovation spillovers to other sectors, both in terms of service
innovation and technology diffusion, include creating preconditions for favorable operating environment for CCIs as well as strengthening them to nurture innovation spill-over on the rest of the economy and society. Starting points in this respect is adopting a separate CCI policy or strategy,\(^\text{154}\) as well as integrating CCI into policies and strategies where CCI have strong links.

**Figure 7.10: CCI Links**

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Table 7.22: SWOT Analysis – CCI Sector

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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<tr>
<td>- Dynamically developing sector</td>
<td>- Poor enforcement of IPR rules</td>
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<td>- Culture of recurring high-level of investment in new technologies and</td>
<td>- Lack of knowledge and skills in IPR management and</td>
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<td>and in increasing staff skills and capacities</td>
<td>- Shortage of creative talent and persons with creative</td>
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<td>- Rich cultural heritage</td>
<td>- Entrepreneurial skills</td>
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<td>- Vibrant domestic market and very high-lever of internationalization</td>
<td>- Severely constrained access to finance for creative</td>
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<td>- Access to the EU Markets, tradition and presence in markets in</td>
<td>- Entrepreneurs and CCI businesses</td>
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<td>Russia, CIS and the Middle East</td>
<td>- Very poor awareness of EU funding opportunities and</td>
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<td>- Limited skill and capacities how to access these</td>
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<td>- Poor collaboration between researchers and CCI</td>
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<td>- Businesses in content development</td>
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<th>Opportunities</th>
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<td>- Increase education on IPR management and</td>
<td>- Unenforced IPR infringements and “stealing of ideas”</td>
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<td>creative entrepreneurship</td>
<td>- CCI sector development bypasses the regulatory</td>
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\(^\text{154}\) Such strategy exists in draft format but does not encompass all key measures needed to foster the development of CCIs to fuel innovation-driven growth.
- Developing CCI business models promoting CCI and creative entrepreneurship
- Radically improve access to finance for CCI businesses and creative entrepreneurs, including through EU funds
- Promoting CCI clusters and establishing creative incubators and hubs

framework governing the businesses
- Establishing monopolies and de facto cartels in certain CCI sectors
- Increasing “brain drain” due to uncompetitive compensation of creative talent and constraining creativity by favoring technical implementation CCI products/services

H. Conclusions and Recommendations

Table 7.23: Sectoral Overview

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<tr>
<th>Sectors</th>
<th>Proposed S3 Business Innovation Instruments</th>
<th>Food Processing</th>
<th>Machinery Building and Electronics</th>
<th>Pharmaceutical</th>
<th>Information and Communication Technology (ICT)</th>
<th>Creative and Cultural Industries (CCI)</th>
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Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013”, financed under Priority Axis 5
"Technical Assistance" of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
Integrated approach and alignment of policies on education and vocational training; scientific research and human capital formation; collaboration between business and research, technology upgrading and diffusion, promoting business-lead R&D; improving protection and enforcement of intellectual property rights and commercialization of research and innovations

National-level coordination body with regional branches

Single governance body and speedier delivery of research and innovation support instruments.

**Regional Specialization (how these industries are performing in each region)**

| Varying degree of clustering, and regional distribution with highest concentration in the South West and South Central Regions (Sofia, Blagoevgrad, Sliven, Plovdiv, Stara Zagora) | Higher level of clustering with highest concentration in the North East, South East, North Central and South Central Regions (Varna, Shumen, Ruse, Gabrovo, Burgas, Sliven, Stara Zagora, Plovdiv) | Higher level of clustering with highest concentration in the South West, North Central and North East Regions (Sofia, Dupnitsa, Razgrad, Troyan, Varna) | Very high level of clustering concentrated in Sofia (over 85%) and some concentration in Plovdiv, Varna Ruse. | Very high level of clustering concentrated in Sofia and clusters in Plovdiv, Stara Zagora, Burgas and Ruse. |

7.121. The case studies suggest that these sectors have the potential to become a true innovation ecosystem, which could be a key driver for this growth. Recent data show that innovative companies in Bulgaria are growing 1.5 times faster than non-innovative companies; they have a greater propensity for export; they attract more foreign direct investment; and they generating more jobs than their non-innovating peers.  

7.122. Bulgaria’s traditional manufacturing industries are facing strong price-based competition from China and the Far East, and quality-based competition from other EU countries. Yet, Bulgaria has export-oriented industries with strong potential for innovation-driven growth. In order for these industries to flourish, they need investment in technological upgrading and research and innovation to increase productivity, reduce energy and water consumption costs and fully build upon competitive advantage presented by relatively low tax burdens and low labor costs. These industries would further benefit from more favorable business enabling environment and increased quality of the human capital. 

7.123. Bulgaria’s competitiveness challenge is to achieve smart growth and specialization, which means making research and innovation a major driver of economic development. Bulgaria has improved its competitiveness and export position in recent years, but it still lags behind other new EU member states. Only 3 percent of its exports consist of high-technology products, far below the EU27 average of 16

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percent. This leaves Bulgaria in an unfavorable position to compete in the increasingly knowledge-based global economy.\textsuperscript{156}

7.124. Food-processing, machine building and electrical equipment, pharmaceuticals and ICT face common constraints to unleashing their innovation potential. Addressing these common constraints will impact a number of industries, with a multiplying effect on innovation-based economic growth. The most critical constraints are:

- Lack of a comprehensive public policy aimed at fostering economic growth based on knowledge & innovation;
- Lack of a single working governance body and mechanisms in the area of innovation;
- Insufficient financial mechanisms for supporting R&D and innovations to develop products and services in the higher-value added market segments;
- Lack of an integrated approach to ensure alignment of the components of innovation, such as education, science, technology, R&D, and commercialization;
- Limited financial resources spent on R&D, and lack of results;
- A patent system that is not effectively used in protecting intellectual property rights, with specific gaps in the protection of service innovation.
- Insufficient collaboration between the business, university and research communities;
- Lack of focus on resource (energy, water) efficient technologies to fully harness the competitive pricing advantage presented by low labour costs, relatively low tax burden, proximity to and traditions in markets in the Middle East and the Former Soviet Union
- Need for a focal point on the innovation ecosystem, presented through flagship innovation platforms, such as the Sofia Tech Park and other parks or initiatives harnessing the innovation potential through the regions
- The slow and cumbersome procedures applied in securing EU funding through the OPC are a deterrent for business innovation and private sector-led R&D and innovations. Carefully crafted instruments and support tools that overcome procedural obstacles are imperative for unlocking the innovation potential of all sectors.

7.125. The results of the case studies have fed into and helped to refine the horizontal recommendations that have been presented in the executive summary and throughout the report. Below are presented key sector specific recommendations.

\footnote{\textsuperscript{156}Ibid.}
Food Sector:

7.126. Integration of policies supporting the innovation based growth in the food processing and the food production sectors: current fragmentation between production and processing has detrimental effect on growth of enterprises in the sector and is causing heavy dependency on imported raw materials.

- Insufficient financial mechanisms for supporting R&D and innovations, as well as ineffective targeting of funds. Integration of support instruments for both food production and food processing is imperative. Current fragmentation between OPs should be eliminated.
- Bridging the gap between private sector demand for innovative solutions and continuing education, health and food-related R&D, solutions for technology and process upgrading, logistics, marketing, sales etc., applicable for the food production and food processing sectors. This can be addressed by establishing business incubators that can support the major food processing segments i.e., wine making, processing of vegetables and fruits, dairy processing, meat processing, etheric oils production etc., or a single Food Innovation Tech Park.
- Promoting information sharing on innovative solutions for the food processing industry due to lacking communication between businesses and research institutions. Efforts in overcoming this shortcoming should be borne by business associations in the various segments (dairy, meat, wine, fruit/vegetables, bio-products) as well as by technology transfer offices in research institutions, government-led initiatives and business incubators/tech park.

Machine Building and Electronics Sector:

- An aging workforce exacerbated by declining number of students in engineering program and drops in the quality of engineering education is becoming a key constraint for innovation and growth of the sector. An avenue to remedy this is to create incentives for engineering education at the university, vocational and professional education and secondary education levels. A further alignment between the business’s needs (utilization of sector competences defined in sectoral analysis developed by Bulgarian Industrial Association) and educational programs, would be an additional positive step in that direction.
- Outdated production infrastructure and lacking access to modern equipment prevent business to unleash their innovation potential. In addition to support for technological and equipment upgrading, support should be directed also to promote forms of cooperation for the sharing of modern infrastructure and equipment in order to provide access to micro and small companies to a high-quality R&D infrastructure. This can be achieved, for example though “pay-for-service” access to advanced technological infrastructure at flagship innovation platforms, such as tech parks.
- The lack of collaboration between businesses, research institutions and universities is an obstacle to commercialization of research and supporting businesses in R&D activities, technology transfer and innovation commercialization.
- Support must be targeted to the innovation ecosystem as a whole, including secondary, vocational and university education, R&D centers (key for technology transfer), young entrepreneurs and start-ups, micro and small innovative businesses.
Targeted support for the replication of successful clusters and business innovation pilot projects: electro/auto mobiles components, mechatronics, hydraulics precision electronics and engineering), to foster a ripple effect of innovation-driven growth sector throughout the sector.

Pharma Sector:

- Removal of unnecessary administrative and regulatory delays for the introduction of new generics on the Bulgarian market. In this way, Bulgarian generic producers would invest more in development activities if they are confident that their medicine will enter the market on day one after the patent expiry;
- Strengthening of the scientific capacity in research organizations and companies to recruit and retaining of young Bulgarian scientists and attracting internationally-recognized experts that can redirect the research agenda into competitive areas within the generic medicine sector or expanding R&D activities in early phases of the clinical trials associated with new drugs, medical compounds and medical delivery systems;
- Directing funding to competitive matching grants for collaboration of medical universities, hospitals, research institutions and private sector representatives in R&D activities in all stages of the clinical trials process. Support schemes for such development activities could be dedicated to procuring specialized machinery and equipment, as well as unique supplies and models used in the research process. Supporting all stages of the clinical trials process, including outsourced late stage clinical trials to Bulgarian hospitals, is critical for the formation of human capital required to develop new, innovative pharmaceutical products and processes for the higher-value added market segment. Late stage clinical trials, apart from providing a revenue stream for hospitals and researchers, also build their knowledge capacity and expertise. In this context, clinical trial phases could be supported both via national funding instruments (national innovation fund and the national science fund), as well as leveraging EU funding.

ICT Sector:

- Bulgaria’s ICT sector is already positioned in the highest value added segments of the global ICT markets. However, the sector experiences a severe shortage of experts with the proper skills for developing products and services for this market. The fast-paced development of the ICT industry requires constant upgrading of technical knowledge, as well as advanced business and social skills and a mindset for innovation at every step. Government support must be devoted to implement pilot models at all educational levels that build social and business skills, as well as promote innovation-prone attitudes. Similar pilot programs are being successfully implemented in selected secondary educational institutions. A large scale implementation of such educational programs (that is based on above 30 key knowledge-society competences) would have a significant impact in bridging sector demand for experts with both technical and business skills and the supply of such experts through both the secondary- and university- level educational institutions. A workforce with the proper skills sets will help the sector unleash its potential to drive innovation-based growth of the economy as a whole.
- The ICT sector has the potential to become the key driver of Bulgaria’s innovation-based economic growth and targeted investments and proper instruments must be developed to
support ideas and projects with the greatest potential for innovation leadership from a global perspective. There is a lack of clear priorities for supporting the ICT sector on political level, including in critical areas such as support through proper instruments, clear and fair rules for doing business and reducing administrative burdens for ICT companies; public financing for R&D not only for ICT but for extending ICT solutions in other sectors of the economy, related support for technology transfer and commercialization of innovative ideas. Targeted government support is needed for facilitate the work of R&D centres, promote university spin-offs, young entrepreneurship and start-ups, as well as to promote successful ICT business sub-segments: BPO’s, shared services, data centres etc., that generate both revenues and build expert capacities.

- Core issue that must be addressed is the significant discrepancy in remuneration of Bulgarian and other EU countries’ researchers participating in FP7 programs. The continuation of this practice is a disincentive to engage Bulgarian researchers in international research partnerships and in a way hinders human capital formation, and could potentially accelerate current “brain drain” trends that would negatively impact local innovation capacity.

Cultural and Creative Industries:

- The core challenge in developing the sector and unleashing its transformative power to foster innovation spillovers in other sectors is attracting and retaining the creative talent, such as architects, designers, advertising creatives, game developers, etc., as remuneration for creatives in Bulgaria is not competitive.

- With the onset of the financial crisis businesses in the CCI sector have been hard pressed to respond to the shrinking markets of CCI products and services, and to balance the constraints these impose on the freedom of artistic expression, as well as on the compensation of creative personnel. Since CCI businesses in Bulgaria retained creative personnel despite shrinking markets, this has resulted in compromising the quality of the creative component of CCI’s products and services.

- The financial “crunch” resulted in diminishing the “creative component” and overemphasizing the importance of the technical delivery mechanisms for CCI products and services. Leaving the CCI sector to fend for itself against market pressures typically diminishes creativity and correspondingly innovation. This in turn decreases the CCI’s ability to define a creative environment that could inspire innovation in other sectors i.e., its take advantage of its transformative power.

- CCI in Bulgaria are severely constrained in accessing the funds they need to finance their activities, both in terms of credit and equity. Considering that most CCI businesses in Bulgaria are micro enterprises or small groups of free-lance practitioners, they do not present the critical mass needed so banks find CCIs commercially interesting enough to analyse CCI projects or develop expertise to understand the special business models of CCIs.
ANNEXES

Annex 1: Analysis of Bulgaria’s export basket

Bulgaria’s exports structure has not evolved significantly over the past few decades since the transition (see Figures below). It remains heavily dependent on natural resources (metals and petroleum with a low or intermediate degree of processing, electrical equipment, apparel and agricultural products) which are characterized by low innovation and are sensitive to commodity prices mechanisms that make its export performance susceptible to long-term success. Based on 2008 data, only 3 percent of the Bulgarian exports can be classified as high-technological products, way below the EU-27 average (16 percent) and on the lower tier of the Eastern European nations (Czech Republic - 13 percent; Hungary- 20 percent; Croatia- 7 percent; Romania- 4 percent; Poland- 3 percent). Among the top ten exports at 2-digit level classification only two (electrical equipment, and boilers and machinery) have a high-tech component.

Figure 7.11: Export basket composition 1995(Net exports)

Figure 7.12: Export basket composition 2010(Net exports)

Source: The Observatory of economic complexity www.atlas.media.mit.edu

The Going for Smart Growth report157 included a review of Bulgaria’s 15 leading export product groups between 2001-08 reviews (at the 2-digit level) by comparing the national change in world market share to the growth of international demand for goods. The two blue lines (change in the world market share=0, and annual growth of all exports=18 percent between 2001 and 2008) divide the chart into four quadrants that characterize the evolution of Bulgarian exports

157 World Bank 2012, Going for Smart Growth: Making Research and Innovation work for Bulgaria
The upper-right quadrant (Champions) includes products that enjoy both fast growth worldwide and good performance by Bulgaria; among them, we find mineral fuels and oils, copper, cereals, and agricultural by-products as well as articles from iron and steel.

Products in the lower-right quadrant (Achievers) are gaining world market share but have yet to see stellar export growth. Several industries with higher technological content, which have a good chance of becoming champions of Bulgarian exports, are in this group: pharmaceuticals, machinery, electrical equipment, and chemical intermediate products (aluminum, plastics).

Products in the upper-left quadrant (Underachievers) are those in which there has been a high demand worldwide, but Bulgaria underperforms the rest of the world, in that it is steadily losing market share; the iron and steel industry stands out.

Products with dim perspectives for future exports include garments and furniture, which occupy the lower-left quadrant (Declining). These products are facing fierce competition from countries like China and India, and increases in labor costs that reduce their international competitiveness.

*Figure 7.13: Dynamic export profile of Bulgaria*

*Note:* the area of the circles corresponds to the export size in $US mil.; the top 15 exports are represented.

*Source:* Going for Smart growth report
Annex 2: Sector Focus Groups

Focus group meetings with key sector representatives including business, academia, and government were held in October and November 2012 in collaboration with MEE.

The meeting of Food-Processing Sector Focus Group was held in Sofia on 19 November, 2012. The objective of the meeting was to gain an overview of the food sector in Bulgaria through guided discussion with stakeholders. The key questions discussed during this Focus Group meeting were:

- How can we transform the food-processing sector’s dependency on imports of raw materials, machinery, equipment, know-how and other input supplies?
- How can we better align the support for food production and processing that are currently fragmented?
- How can we integrate the cost-effective technologies and equipment that are currently outdated preventing specialization in high-value added processing an innovation intensive activities?
- How do public instruments for financing R&D and innovation in the sector can be improved, including EU funding schemes?
- How can collaboration between the businesses and research institutions be improved, including ecosystem integration and collaboration between private and public sector?
- How can we bridge the gap between private sector demand and research institutes supply of innovative technologies, seeds, solutions?

List of Participants – Food Processing Regional Focus Group, November 19, 2012

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<td>1.</td>
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<td>Nikolay Nikolov</td>
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The meeting of Machinery Building and Electronics Sector Focus Group was held in Sofia on 8 November 2012. The objective of the meeting was to gain an overview of the respective sector in Bulgaria through guided discussion with stakeholders. The key questions discussed during this Focus Group meeting were:

- How is it possible to provide and maintain the human capital required for the industry?
- Can we reverse the low added trend in the value of the machinery and equipment into high value?
- Can we successfully increase innovation and R&D in the sector?

List of Participants – Mechatronics Focus Group meeting on November 8, 2012

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<td>Emilia Radeva</td>
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The meeting of the Pharmaceutical Sector Focus Group was held in Sofia on 7 November 2012. The objective of the meeting was to gain an overview of the Pharmaceutical sector in Bulgaria through guided discussion with stakeholders. The key questions for this Focus Group meeting were:

- Can we provide and maintain the human capital required for the industry?
- Can we increase R&D expenditure by public and private partners?
- Can we increase the efficiency of these investments?
- Can we improve the regulatory environment for business?
- Can we develop in the future international cooperation with major R&D centers and science?
- Can we increase the absorption of EU funds for the sector through the new OP "Innovation and Entrepreneurship" through VII Framework Programme of the European Commission?

**List of Participants – Pharma Focus Group meeting on November 7, 2012**

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The meeting of the ICT Sector Focus Group was held in Sofia on 23 October 2012. The objective of the meeting was to gain an overview of the ICT sector in Bulgaria through guided discussion with stakeholders. The key questions discussed during this Focus Group meeting were:

- Can we assure and sustain the required by the industry human capital with ICT knowledge?
- Can we/should we achieve higher sector diversification, in terms of the revenue? (Almost 70% of the entire revenue comes from the telecommunication sector)
- Bulgaria has been ranked 9th in the A.T. Kearney’s annual ranking of the most attractive locations for “offshoring” of service activities such as IT, business processes and call centers. Can we leverage on that opportunity?

List of Participants – ICT Focus Group meeting on 23 October, 2012

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<td>Borislav Borisov</td>
<td>VMware</td>
<td>R&amp;D Director</td>
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<td>Gergana Dimitrova</td>
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<td>Diana Popova</td>
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<td>Dobromir Dobrev</td>
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<td>Administrative Director,</td>
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<td>Elena Marinova</td>
<td>Musala Soft</td>
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<td>Evelina Christova</td>
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<td>Emil Komatchiev</td>
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Project: BG161PO003-5.0.01-0003 “Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy” 2007-2013”, financed under Priority Axis 5 “Technical Assistance” of the Operational Programme, co-financed by the European Union through the European Regional Development Fund
The meeting of the Cultural and Creative Industries (CCI) Sector Focus Group was held in Sofia on 27 February 2012. The objective of the meeting was to gain an overview of the CCI ICT sector in Bulgaria through guided discussion with stakeholders. The key questions discussed during this Focus Group meeting were:

- What can be done to bring the creative industries closer to researchers and the academia to expand content?
- What can be done to eliminate the “invisible ceiling” in the creative industries’ markets and ensure an “even playing field” for all - what can the government do?
- What needs to be done to improve the regulatory environment (and IPR) of the creative industries?
industries?

- What can be done to better target private funding for service innovation? How can the government help?
- What can the government do to increase the innovation impact of the creative industries – how to target EU funding through the new OP-IC?
- What must be done to support the creative industries in serving as an engine of innovation (spill-over effect) and industrial change in Bulgaria?
List of Participants of CCI Focus Group February 27, 2013

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<tr>
<th>No.</th>
<th>Name</th>
<th>Institution</th>
<th>Position</th>
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<td>1</td>
<td>Rozalia Radichkova</td>
<td>Ivan Vazov National Theater</td>
<td>Producer</td>
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<td>Milena Chervenkova</td>
<td>ART Theater</td>
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<td>4</td>
<td>Sylvana Milenova</td>
<td>Web and Events Group</td>
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<td>Ivan Nestorov</td>
<td>Sofia Music Enterprises</td>
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<td>Joker Media</td>
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<td>Peter Petrov</td>
<td>Balkan Entertainment Company</td>
<td>Managing Partner</td>
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<td>Boris Begumov</td>
<td>Ticketstream</td>
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<td>Dessislav Stoyanov</td>
<td>Bon Promotions</td>
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<td>Ivaylo Stoyanov</td>
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<td>Rossen Missov</td>
<td>Bulgarian Association of Advertisers (BAA)</td>
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<td>12</td>
<td>Dora Vassileva</td>
<td>Bulgarian Web Association</td>
<td>Chair</td>
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<td>Krassimir Papazov</td>
<td>Ogilvy Bulgaria</td>
<td>Executive Director</td>
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<td>14</td>
<td>Ivan Kirov</td>
<td>Mccann Ericsson</td>
<td>Creative Director</td>
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<td>Ivana Tsakova</td>
<td>Hopper Maps</td>
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<td>Dimitar Dimitrov</td>
<td>Cinema Box Office</td>
<td>Executive Director</td>
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<td>17</td>
<td>Elitsa Panova</td>
<td>Ciela Publishing</td>
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<td>18</td>
<td>Georgi Bakalov</td>
<td>Union of Architects</td>
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<td>Lubiomir Pelovski</td>
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<td>Vanya Furnadjieva</td>
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<td>Dimitar Dobrev</td>
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<td>VIAS</td>
<td>Professor</td>
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