BULGARIA

Reimbursable Advisory Services Program on Innovation

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

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Private and Financial Sectors Development Department
Europe and Central Asia Region
The World Bank

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CURRENCY AND EQUIVALENT UNITS
(as of January 6, 2013)

Currency Unit = BGN (Bulgarian Lev)
US$1 = 1.5 BGN
1 BGN = US$0.66

WEIGHTS AND MEASURES
Metric System

ABBREVIATIONS

<table>
<thead>
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<th>Description</th>
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<tbody>
<tr>
<td>3S</td>
<td>Smart Specialization Strategy</td>
</tr>
<tr>
<td>BAS</td>
<td>Bulgarian Academy of Sciences</td>
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<tr>
<td>BDA</td>
<td>Bulgarian Drug Agency</td>
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<tr>
<td>BPO</td>
<td>Business Process Outsourcing</td>
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<td>BURS</td>
<td>Bulgarian Universities Ranking System</td>
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<tr>
<td>CCU</td>
<td>Central Coordination Unit</td>
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<tr>
<td>CEG</td>
<td>Council For Economic Growth</td>
</tr>
<tr>
<td>CEO</td>
<td>Chief Executive Officer</td>
</tr>
<tr>
<td>CNIC</td>
<td>The National Innovation Council for Competitiveness of Chile</td>
</tr>
<tr>
<td>COM</td>
<td>Cabinet of Ministers</td>
</tr>
<tr>
<td>CR&amp;D</td>
<td>Collaborative Research and Development Programme</td>
</tr>
<tr>
<td>DCE</td>
<td>Department of Chemical Engineering</td>
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<tr>
<td>EC</td>
<td>European Commission</td>
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<tr>
<td>EGA</td>
<td>European Generic Medicines Association</td>
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<tr>
<td>EPS</td>
<td>Expert Panels</td>
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<tr>
<td>EVIC</td>
<td>Electric Vehicles Industrial Cluster</td>
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<tr>
<td>FDI</td>
<td>Foreign Direct Investment</td>
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<tr>
<td>FP7</td>
<td>Seventh Framework Programme</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GOB</td>
<td>Government of Bulgaria</td>
</tr>
<tr>
<td>GPRA</td>
<td>Government Performance and Results Act</td>
</tr>
<tr>
<td>HAACP</td>
<td>Hazard Analysis and Critical Control</td>
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<tr>
<td>HAC</td>
<td>Higher Attestation Commission</td>
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<tr>
<td>HEI</td>
<td>Higher Education Institutions</td>
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<tr>
<td>ICT</td>
<td>Information And Communication Technology</td>
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<tr>
<td>IP</td>
<td>Intellectual Property</td>
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<tr>
<td>IPO</td>
<td>Initial Public Offering</td>
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<td>IPR</td>
<td>Intellectual Property Rights</td>
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<tr>
<td>MBE</td>
<td>Machine, Building and Electronics</td>
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<tr>
<td>M&amp;E</td>
<td>Monitoring and Evaluation</td>
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<tr>
<td>MEET</td>
<td>Ministry of Economy, Energy and Tourism</td>
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<tr>
<td>MEYS</td>
<td>Ministry of Education, Youth and Science</td>
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<tr>
<td>NATT</td>
<td>National Association for Technology Transfer</td>
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<tr>
<td>NEAA</td>
<td>National Evaluation and Accreditation Agency</td>
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<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
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<tr>
<td>NCI</td>
<td>National Council for Innovation for MEET</td>
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<td>NCSR</td>
<td>National Council for Scientific Research for MEYS</td>
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<td>NIB</td>
<td>National Innovation Board</td>
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NIF  National Innovation Fund
NIS  National Innovation Strategy
NPR  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
OSS One-Stop Shop
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
RDI 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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Executive Summary

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 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 submission of a Smart Specialization Strategy (see Box 1) should be an ex ante conditionality for access to Structural Funds in the 2014-20 period.

Box 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.


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 1 on R&D spending), outputs (see Table 2 and Table 3 on patents), or by the contribution of innovation to economic growth (see Figure 1 on high-tech exports). This is despite the adoption of a National Innovation Strategy in 2004, the development of a National Reform Program 2011-2015 (which set 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. The 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.

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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, Energy and Tourism (MEET), to strengthen the national innovation system at both the institutional and policy levels.
Table 1: Bulgarian firms’ innovation performance relative to the EU-27 average

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

*Source: EC Innovation Union Scoreboard 2011.*

Figure 1: High-tech manufacturing exports (% of total)

*Source: World Development Indicators*

Table 2: Patents granted by USPTO (per million inhabitants)

<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 3: Patents granted by EPO (per million inhabitants)

<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), which serves as 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. An evaluation of Bulgaria’s innovation system reveals three major areas 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 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 an independent Advisory Council and 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 in the development of the innovation system. 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 lack of funding for research in the universities has reduced the attractiveness of careers in science and engineering among recent graduates. By better coordinating its efforts to align the incentives of all actors in the national innovation system, 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 constant 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.

5. The EC has provided extensive guidelines for 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 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 roadmapping, a collaborative process for developing common innovation goals. Engaging in this process will enable Bulgaria to develop a vision which 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.

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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.

**Overview of the report**

6. **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. Under the EC’s Europe 2020 strategy, the Government of Bulgaria has committed to implementing new policies and larger investments to gradually increase Bulgaria’s innovative capacity and R&D intensity. 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.

7. **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 aims to identify the key inputs for the creation of Bulgaria’s Smart Specialization Strategy. The report examines the key factors affecting the development of a vibrant and well-functioning national innovation system, and concludes with case studies on four key sectors where there is potential to benefit from an increase in innovation-driven investment. The report covers the following areas:

**Entrepreneurship: Stimulating innovation and high-impact entrepreneurship**

8. **This section 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.

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

![Innovative characteristics of SMEs](chart.png)

**Figure 2: Innovative characteristics of SMEs**

10. Creating a conducive business environment is a necessary but not sufficient condition for fostering innovation. 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 innovation, the government should specifically 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) stronger linkages between research and business; (c) effective funding mechanisms (be it through EC Operational Programs, national instruments, venture capital); and (d) a functional system for commercialization of technology. 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.

11. Bulgarian legislation on intellectual property protections is broadly in line with EU directives in all significant areas, but has failed to spur indigenous innovative activity. 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.

12. **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, and in-house research by firms. 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, trade secrets, copyright and related rights, new varieties of plants, non-original databases, and relevant aspects of unfair competition law. Streamlining the IPR application process and reducing transaction costs would also go a long way toward facilitating 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 IPR process in Bulgaria.

13. **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 innovation instruments.** Technology roadmapping, 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, should help to 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 roadmapping, and 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. The use of independent facilitators will help ensure the integrity of the process and minimize the potential for capture by special interests, which can render the entire exercise ineffective.

14. **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 instruments for

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3 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 public research organizations (PROs) are the property of the government.
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.

15. There is significant room for improvement and expansion of 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:

a. Further institutional reforms are critical to improve policy design and implementation. Despite recent institutional changes, Bulgaria’s OPC management structure needs further reform: (i) the institutional setup is not in line with international good practices, which suggests that the development of an independent, stand-alone specialized agency can be 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 the long-term perspective needed to develop the capacity for effective implementation; (iii) MEET 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.

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 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.

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 OP IE 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 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

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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 Advisory Services program.
the eligibility 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 OP Innovation and Entrepreneurship to be developed for the 2014-2020 cycle (OPIE) is an opportunity to introduce new innovation instruments targeting various stages of the innovation value chain.** The OPIE 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) Mobile Industry Applications Labs that would provide the necessary infrastructure for the deployment and scaling up of mobile applications; (iv) A Network of Technology Transfer Offices with an off-campus office providing specialized services in research commercialization; (v) Programs promoting collaboration with Bulgaria’s highly skilled Diaspora that would result in connection to the global knowledge networks and innovation experts; (vi) Innovation Vouchers for SMEs that would encourage behavioral change in SMEs in traditional sectors towards innovation (see Table 4).

**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 OP IE. 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 4: 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</td>
<td>Identification of hi-tech startups and investment in innovative business</td>
<td>Focus on picking the best ideas</td>
</tr>
<tr>
<td>accelerator</td>
<td>ideas</td>
<td>Use of incentives that will incubate high-growth businesses</td>
</tr>
<tr>
<td></td>
<td>Facilitate knowledge diffusion and technological upgrading in low and</td>
<td>Strong involvement of universities</td>
</tr>
<tr>
<td></td>
<td>medium-tech sectors</td>
<td>Evaluation committee of business experts should make financing decisions</td>
</tr>
<tr>
<td>Proof of concept labs for</td>
<td>Removes barriers such as start-up funding, access to equipment, and</td>
<td>Type of lab should be conditioned on private sector interest</td>
</tr>
<tr>
<td>prototyping and piloting</td>
<td>access to expertise</td>
<td></td>
</tr>
<tr>
<td>Mobile Applications</td>
<td>Would further boost Bulgaria’s</td>
<td>The lab could be set up in partnership</td>
</tr>
</tbody>
</table>
### Instrument

<table>
<thead>
<tr>
<th><strong>Lab</strong></th>
<th><strong>Rationale</strong></th>
<th><strong>Best practices</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>competitive advantage in the sector by providing an enabling environment for promising entrepreneurs and supporting the development of bottom-up innovation communities.</td>
<td>with private capital venture capitalists, local and international universities, technical colleges and business schools, industry leaders, including operators, device manufacturers and content providers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Technology Transfer Office Network</strong></th>
<th><strong>Rationale</strong></th>
<th><strong>Best practices</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimization of technology transfer services in a cost-effective way. The activities of TTOs would focus on: i) technology transfer promotion, ii) assessment of the demand, and iii) potential disclosures; while off-campus office is responsible for technical assistance in commercialization.</td>
<td>Having TTOs specialize in different areas to foster collaboration and contracting between TTOs</td>
<td></td>
</tr>
</tbody>
</table>

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<tr>
<th><strong>Diaspora collaboration program</strong></th>
<th><strong>Rationale</strong></th>
<th><strong>Best practices</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>Initiatives promoting diaspora entrepreneurship have been developed across various countries and with different focus, e.g. research, networking mentoring, training and venture capital partnerships</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Innovation Vouchers</strong></th>
<th><strong>Rationale</strong></th>
<th><strong>Best practices</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Encouraging behavioral change in SMEs in traditional sectors towards innovation through technical assistance. Incentivize innovation in SMEs through collaboration with knowledge based institutions.</td>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

16. **The Sofia Tech Park, once completed, should provide the necessary infrastructure to house some of these innovation instruments.** Given the different actors in the innovation system, the tech park could go a long way toward reducing coordination failures. It could also house 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.

17. **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.

18. **The recent EUR21 million acceleration and seed funding of privately managed funds Eleven and Launch Hub under the JEREMIE initiative using OPC funds is a welcome development.** However, 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\(^5\) 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.

**Governance: Developing a comprehensive framework**

19. **This section highlights the need for a stronger governance framework for the government’s innovation efforts.** This chapter analyzes the challenges of developing a sound governance structure for the Public 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.

20. **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, Youth and Science (MES) and the Ministry of Economy, Energy and Tourism (MEET) 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 clear legal mandate.

21. **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 major 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

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uncoordinated agendas, responding to pressure from their constituencies, making the government support marginal, with limited effect in business behavior.

22. **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 (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.

23. **To develop a comprehensive governance framework to support and promote the national innovation agenda the government should establish a National Innovation Board (NIB) 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.
24. An important role for the NIB 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 NIB 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. 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 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. Since it is difficult to measure the progress of initiatives with a long maturation period, the NIB should establish intermediate indicators that indicate the direction and pace of change.

25. In line with international best practice, an autonomous 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 NIB 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 NIB 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 National Innovation Board—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 NIB with right of voice for bringing strategic long term perspective into policy making and program design and providing feedback from stakeholders.

26. **A stand-alone public 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 will also be responsible for: i) implementation of program including call for proposals, evaluations and award decisions, and ii) providing regular feedback to the NIB 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.

27. **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 are important management tools for 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.

28. **The development of the Smart Specialization Strategy presents an excellent opportunity to launch the NIB and the 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 NIB could then formally approve once it was finalized. The NIB 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.
Research: Developing a globally competitive and economically relevant research sector

29. This section 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, Bulgaria has an unparalleled opportunity to transform itself into a knowledge-based and R&D-led economy by excelling in research and science. 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.

30. Bulgaria’s inadequate research and knowledge infrastructure has led to a decline in scientific productivity and reversing this decline is a major policy challenge. The benchmarking of Bulgaria’s research system and review of its key institutional and funding aspects point to five interconnected objectives that need to be integrated into the RIS3 priorities and be the focus of regular monitoring and evaluation:

- Addressing institutional imbalances in the research system
- Establishing incentive systems that promote excellence
- Making scientific specialization responsive to the need for economic specialization
- Making research careers more attractive and retaining talent
- Stepping up R&D, commercialization, and public-private cooperation.

31. 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, which by its nature has limited applications; (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) high-quality research is conducted almost exclusively in Sofia. Since advantages from research tend to accumulate over time, this imbalance is inhibiting other regions from developing knowledge-based economic activities. A first step toward resolving this issue would be to commission a system-wide independent evaluation to assess all PROs. A second step would be to convene a high-level task force to agree on a roadmap to implement the recommendations of the independent experts. The third step would be to initiate restructuring of PROs, taking care to 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.

32. Allocating more funding to research could have a major economic and development impact, provided the right funding mechanisms are used. Achieving the national R&D investment target of 1.5 percent of GDP by 2020 implies an increase in public R&D of 0.5 percent of GDP in real terms over the S3 period if the ratio of public-to-private R&D spending remains at today’s level of 50 percent. Part of this increase will come from improved absorption of future EU funds earmarked for innovation. The rest would need to come from a boost in national budgetary funds. 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. To maximize
impact, future increases in institutional funding should be made conditional on PRO performance. Ideally, the funding would be allocated on the basis of regular, independent monitoring and evaluation of each PRO’s performance. Funding could be allocated 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. 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.

33. **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 proposed Advisory council should play a leading role in identifying those scientific areas that are key for development of the national economy. 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 the 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 NSF instruments, the delivery mechanisms for science funding need to be improved.

34. **A merit-based funding program to retain and attract top scientists as well as young researchers with clear potential needs to be introduced to 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 much 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, the knowledge transfer activities undertaken and the quality of their proposals. These grants are likely to have a bigger impact on the economy when they are given to the most promising researchers working in research centers with links to universities.

35. **To foster greater R&D commercialization, policies that encourage IP disclosure, IP monetization, and public-private collaboration should be pursued.** Many obstacles can emerge during the commercialization process, and the most important task for policymakers is to facilitate the necessary collaboration between researchers and industry. In Bulgaria, as in many countries, “the problem is not so much the [lack of] commercialization activity but whether the conditions for a massive and systemic (as opposed to rare and occasional) process of research commercialization are

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6 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.
in place.”

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 central TTO that coordinates with local TTOs would be the best option for reinforcing commercialization activities.

36. **The Smart Specialization Strategy has the potential to set in motion a comprehensive set of funding and institutional reforms that can move the country toward achieving these objectives.** For Bulgaria to achieve its goal of becoming a competitive EU partner and a moderate innovator by 2020, sequenced and well-coordinated actions will be necessary. These actions will need to be embraced by system stakeholders and aligned with commitments at the heart of both the National Strategy of Scientific Research to 2020 and the Smart Specialization Strategy.

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

37. **This section addresses the need for skilled human capital to meet the demands of a knowledge economy.** The chapter 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.

38. **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.

39. **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) improving the higher education system; ii) increasing synergies between research and teaching institutions; iii)

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7 Correa, Paulo et al., Inception Report for Regional R&D Strategy for Innovation in the Western Balkan Countries, August 2011.
putting in place incentives to retain talent and reward excellence; and iv) facilitating researchers’ participation in international forums and communities of practice.

40. **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)\(^9\) initiative. Under this initiative, the Ministry of Education is disclosing the performance of Bulgarian universities online. By including indicators of which universities and courses of study produce a disproportionate number of unemployed graduates, or graduates taking low-quality, or low-paid jobs, the system gives students valuable information and puts pressure on universities to reassess the courses of study they offer. However, some universities are still resistant to the idea that they should be responsive to the needs of the labor market. While labor market performance is not a perfect indicator of quality of education (in fact many professions such as teaching have social returns that vastly exceed the compensation received), it is an important one and therefore the government’s efforts should be commended and expanded further using other indicators that signal positive learning outcomes.

**Figure 4:** University graduate earnings by university (BGN/month)

![Graph of University Graduate Earnings](http://rsvu.mon.bg)

*Source: Rankings of Bulgarian Universities*

41. **Incentives are needed to encourage students to pursue technical and engineering studies.** Too many university students choose areas of study, where there are clear signs of oversupply, such as economics and law. Incentives to pursue technical and engineering studies can include scholarships, shorter and more focused training courses to develop the competencies required in

\(^9\)http://rsvu.mon.bg
different professions; and the creation of new clusters to improve linkages with business and make use of those competencies.

42. **An integral piece of the government’s support should be focused on making higher education more responsive to the needs of industry.** This can be done by creating incentives for university/business collaboration; developing courses with industry input and offering scholarships in collaboration with industry. Evidence shows that institutions of tertiary education can contribute to better labor market outcomes by: i) 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.; and ii) 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 key to success. Currently internships are 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.

43. **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 refocusing funding mechanisms at universities towards skills required by key sectors; and expanding access to and eligibility for student loans.** Coordination between the EU operational programs, for example coordination between the Human Resource Development Program and the Competitiveness Program in designing and implementing workforce development measures should go a long way to increasing the impact of the programs.

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

44. **This section underscores the importance of an evidence and results-based approach to innovation.** The chapter discusses the importance of incorporating experimentation and learning into the M&E framework, creating feedback loops from evaluation to program design and policymaking, and the need to replace static monitoring indicators with state-of-the-art impact evaluation methodologies.

45. **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.

46. **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.

47. **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.

48. **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.

49. **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.

50. **A review of these indicators in both 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 RISP. 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.
51. **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**

52. **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 export-oriented industries, including pharmaceuticals and ICT, with strong growth potential. For both traditional and emerging industries to flourish, they need investment in research and innovation to increase productivity and build niche competitive advantage. They also need a favorable business environment and high-quality human capital.

53. **This section illustrates the issues addressed in the previous sections as experienced by industry.** It includes a cursory examination of four key sectors in Bulgaria which could significantly benefit from innovation and technology transfer – food processing, machinery building and electronics, pharmaceuticals, and information and communication technology. The case studies, based on extensive consultations with industry participants and desk research, examine the existing strengths and weaknesses of the four 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.

54. **The four sectors profiled in this report are food processing, machine building and electrical equipment, pharmaceuticals, and ICT.** These sectors which were discussed and agreed in advance with the government were chosen by applying the following key criteria (Figure 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 5: Sector Selection criteria

<table>
<thead>
<tr>
<th>Sector</th>
<th>Sector-specific constraints to innovation</th>
<th>Cross-cutting constraints to innovation</th>
</tr>
</thead>
</table>
| Food processing | - Lack of technological and equipment upgrading  
                   - Insufficient supply chain | - Shortage of skilled labor  
                                       - Lack of collaboration between the business, university and research communities  
                                       - 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 |
| Mechatronics | - Large number of small players at lower end of the value chain |  |
| Pharmaceuticals | - Lack of transparent regulation and procedures for early stage clinical trials |  |
| ICT | - Inadequate system for protection for ICT related assets such as service innovation and business process innovation |  |

55. **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.

Table 5: Constraints to innovation

<table>
<thead>
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56. **The case studies for the four sectors which were completed based on extensive stakeholder consultations and desk research are summarized below.**
I. Food Processing

57. 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. All segments of the food processing sector are dominated by imports, with the greatest share in meat, poultry, fruits and vegetables, and organic products.

58. 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 6: SWOT Analysis for the Bulgarian Food Processing

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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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>- Low level of R&amp;D and innovation intensity</td>
</tr>
<tr>
<td>- High standards for food quality and safety and</td>
<td>- Weak collaboration between businesses in the sector, universities and research institutions</td>
</tr>
<tr>
<td>- Well-developed transportation and distribution network</td>
<td>- Outdated facilities and technologies resulting in high energy and water consumption</td>
</tr>
<tr>
<td>- Low labor costs</td>
<td>- Inefficient supply chain due multiple intermediaries and</td>
</tr>
<tr>
<td>- Access to the EU Markets, tradition and presence in markets in Russia, CIS and the Middle East</td>
<td>- 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</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 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>
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10Wine, 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)
II. Pharmaceuticals

59. 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 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\textsuperscript{11}, and the sector is expected to grow\textsuperscript{12} 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.

60. 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).

61. 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.

<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</td>
<td>- Limited experience in R&amp;D associated with new drug development and early stage clinical trials</td>
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</tbody>
</table>

\textsuperscript{11} The highest in EU with the exception of Greece
\textsuperscript{12} Business Monitor International forecasts that the market will continue to grow in 2010-2013 at a compound annual rate of 9.1 percent.
with international partners in new drug and medicinal compound production and associated early stage clinical trials leveraging the presence of multinational pharmaceutical companies

- High export volumes of generic drugs to markets in Western Europe, Russia and CIS and the Middle East

**Opportunities**

- 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
- 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

**Threats**

- Strong dependency on generic drugs - competition from Asian companies in the generics drugs segment could have negative impact on the sector
- Onerous business regulation/high barriers to entry of new generic products on the market
- Lack of transparent regulation and procedures for early stage clinical trials
- Third countries’ informal competition, parallel imports of generic drugs
- Brain-drain of qualifies researchers engaged in collaborative R&D due to low salaries in Bulgaria

**III. ICT**

62. 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. The sector is equally divided in three key sub-segments: telecommunications\(^\text{13}\), 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 exports\(^\text{14}\) 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).

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\(^{13}\) Mobiltel, Cosmo Bulgaria Mobile, and BTC are the three main telecom players, and account correspondingly for 28, 20, and 6 percent of revenues.

\(^{14}\) Broadband Quality Score 2009 (BQS); Invest Bulgaria Factsheets, InvestBulgaria Agency, 2011
### Table 8: SWOT Analysis for the Bulgarian ICT

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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<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>
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<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>
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<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>
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<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>
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<tr>
<td>- Well-developed ICT infrastructure including high-speed broadband.</td>
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<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Small but growing domestic market, access to and presence in global markets</td>
<td>- Dependence on foreign companies for patent development</td>
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<tr>
<td>- Upcoming e-Government initiative will spur further innovation and growth</td>
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<tr>
<td>- Opportunity for technological absorption through FDI</td>
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<tr>
<td>- Leveraging diaspora knowledge and networks can create opportunities for higher value added further development and global capacity</td>
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<tr>
<td>- BPO, R&amp;D and data centers growth opportunities are significant. ICT cluster could further develop outside Sofia.</td>
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<tr>
<td>- 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.</td>
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</table>

63. **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 has the highest levels of innovation intensity of all sectors in Bulgaria: it 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 Seventh Framework Programme (FP7). Software, 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.
64. Bulgaria is recognized as a good destination for outsourcing and offshoring.\textsuperscript{15} 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.

65. 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

66. Bulgaria’s machine building sector has a heavy export orientation\textsuperscript{16} accounting for close to 15 percent of the country’s total exports. More than half all sector production is exported\textsuperscript{17}, 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.

67. 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.

68. 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.

69. 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

\textsuperscript{15} The country has been ranked the 9\textsuperscript{th} most attractive location for offshoring of service activities such as IT, business processes, and call centers (A.T. Kearney, 2009) and as the 13\textsuperscript{th} best destination for outsourcing (Economist Intelligence Unit, 2010).

\textsuperscript{16} 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.

\textsuperscript{17} The biggest revenue producers are the electronics components and electric domestic appliance subsectors.
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 9: Machine-Building and Electrical Equipment Sector SWOT Analysis

<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>
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<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>
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<td>Engineering education in need of upgrading</td>
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<table>
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<tr>
<th>Opportunities</th>
<th>Threats</th>
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<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>
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<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>
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</table>

18 Examples include energy saving LED- based technologies, advanced hydraulics components, electronics for the automotive industry, precision engineering equipment.
## Summary of Recommendations

<table>
<thead>
<tr>
<th>Area</th>
<th>Strategic Objective</th>
<th>Recommendations</th>
<th>Medium and Long-term</th>
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</thead>
<tbody>
<tr>
<td>Stimulating Business Innovation and Entrepreneurship</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>
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<td>• effective funding mechanisms (Operational Programs, national instruments, venture capital)</td>
<td>• identify the challenges of the industry,</td>
<td>• government funded research</td>
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<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 the technology gaps and R&amp;D projects that would 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>Improve innovation funding instruments by:</td>
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<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 and control the entire 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 rigorous impact evaluation to measure the additionality of different instruments</td>
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<td>• improving the coordination with other ministries so that the results achieved are visible.</td>
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<td>Ensure the instruments housed within the Sofia Tech park are demand driven and that the private sector is adequately represented in its governance</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
<table>
<thead>
<tr>
<th>Area</th>
<th>Strategic Objective</th>
<th>Recommendations</th>
<th>Medium and Long-term</th>
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<tbody>
<tr>
<td>Governance</td>
<td>Develop a comprehensive governance framework to support and promote the national innovation agenda</td>
<td>Establish an Implementation Agency, to:</td>
<td>Develop and refine coordination mechanisms among governance agencies, sector ministries, research institutions, industry</td>
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<td>- design and implement administration of instruments</td>
<td>Develop public participation mechanisms and reporting channels</td>
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<td>- provide regular feedback to the NIB about what works and does not work, to inform future policy decisions</td>
<td>Refine quality standards and M&amp;E indicators based on learning and feedback</td>
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<td>Establish a National Innovation Board, to:</td>
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<td></td>
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<td>- coordinate policymaking across sectors</td>
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<td>- monitor and evaluate innovation policies and strategies</td>
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<td>- ensure that regional issues are taken into account</td>
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<td>Establish an Advisory Council, to:</td>
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<td>- focus on long-term strategic issues and</td>
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<td></td>
<td></td>
<td>- provide specific knowledge and guidance to NIB</td>
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<tr>
<td>Research</td>
<td>Develop a globally competitive and economically relevant research system</td>
<td>Address institutional imbalances in the research system by:</td>
<td>Initiate the restructuring of PROs taking into consideration the lessons learned from other ECA countries</td>
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<td>- Commissioning a system-wide independent evaluation to assess and rank all PROs</td>
<td>Create centers of excellence that have a strong position in European research</td>
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<td>- Convening a high-level task force to discuss and agree on a roadmap for restructuring BAS institutes and the universities that would distribute research funds and human resources more equitably throughout the system.</td>
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<td>Improve the efficiency of</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>Expand efforts to introduce accountability into higher education financing, and consolidate the sector based on performance</td>
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<td></td>
<td>• improving the higher education system</td>
<td>• develop additional indicators (aside from labor market performance) to assess performance of higher education institutes.</td>
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<td>• increasing synergies between research and teaching institutions</td>
<td>Provide incentives for studying science and technical</td>
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<td>• putting in place incentives to retain talent and reward excellence</td>
<td>Increase share of the people aged 30-34 with higher education to 36 percent by 2020 by:</td>
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<td></td>
<td>• facilitating</td>
<td>• improving coordination and refocusing funding mechanisms at universities towards skills required by key</td>
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public expenditures on research by:
- Making funding increases conditional on the performance of PROs, based on independent monitoring and evaluation.
- Matching the resources that PROs can secure from external sources to realign the incentives.

Redesign scientific support instruments to target collaborative and mission oriented research by building the capacity of existing research teams and facilitating the creation of public-private research consortia

Introduce a merit-based funding program to retain and attract top scientists and young researchers with clear potential based on regular independent evaluations

Develop policies that encourage IP disclosure, IP monetization, and public-private collaboration by establishing a central TTO and strengthening the network of TTOs.

Short-term

Medium and Long-term
<table>
<thead>
<tr>
<th>Area</th>
<th>Strategic Objective</th>
<th>Recommendations</th>
<th>Medium and Long-term</th>
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<tbody>
<tr>
<td></td>
<td>participation in international communities of practice</td>
<td>specialties, and increase opportunities for academic careers in those areas</td>
<td>sectors</td>
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<td></td>
<td>• addressing regional imbalances in education and research opportunities</td>
<td>Make higher education more responsive to the needs of industry by:</td>
<td>• expanding access to and eligibility for student loans</td>
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<td>• creating incentives for university/business collaboration</td>
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<td>• developing courses with industry input</td>
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<td>• offering scholarships in collaboration with industry</td>
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<td>Monitoring and Evaluation</td>
<td>Use monitoring and evaluation as a policy tool to track performance, determine the impact of interventions, and provide feedback to improve implemented policies</td>
<td>Strengthen institutional capacity for M&amp;E, and integrate M&amp;E into every stage of the innovation process, from strategy design through implementation (measurement of intermediate outputs) and final evaluation of impact</td>
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<td>Introduce an M&amp;E framework to evaluate the performance of each implemented program and to enable evidence based policy reforms.</td>
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<td>Develop an M&amp;E framework with clear and measurable indicators for every program and intervention to:</td>
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<td>• 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</td>
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<td>• refine programs as necessary based on results</td>
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<td>• provide guidance to independent experts in evaluating program outcomes to assess whether desired results have been</td>
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Develop body of knowledge and guidance for practitioners based on learning from M&E.
### Table: Recommendations

<table>
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<tr>
<th>Area</th>
<th>Strategic Objective</th>
<th>Short-term</th>
<th>Medium and Long-term</th>
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<td>achieved</td>
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<td>• observe whether the implemented policies crowd in additional investments</td>
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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.

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)

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 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.

19 EU10 countries are the new EU member states: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.
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.

1.7 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.

1.8 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

1.9 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.

1.12 All of the planning regions within Bulgaria have created Regional Innovation Strategies (RIS) under the auspices of the EC’s “Innovating Regions in Europe” initiative. Bulgaria has six planning regions – South-West, South-East, South-Central, North-East, North-West, and North-Central – all of which developed, between 2001 and 2008, their own respective frameworks for implementing R&D and innovation strategies within their territories. However, the recommendations from these regional strategies have generally not been adopted at the national level; instead, they have been only partially incorporated in Strategies for Regional Development and incorporated into the National Strategy for Regional Development.

C. Smart Specialization Strategy – the path to sustainable growth

1.13 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 1.1) should be an ex ante conditionality for access to Structural Funds in the 2014-20 period.

Box 1.1: 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 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

1.14 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

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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.

70. In line with EC guidelines20, the report covers the following areas:

a. **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 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.

b. **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.

c. **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.

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 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.

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 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. Creating a conducive business environment is a necessary but not sufficient condition for fostering innovation. To start with, the government must 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. 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.”

2.3. 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 report by the World Bank, given that corruption is one 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, while promoting private investment and risk sharing.

B. An overview of entrepreneurship and innovation in Bulgaria

2.4. 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 (Figure 2.1 and Figure 2.2). Only 765 employees in the country work for an SME (defined by the EU as companies with fewer than 250 workers). A study commissioned under the Seventh Framework program\(^{23}\) 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 2.4). 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.

\(^{23}\)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

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**Figure 2.1: Bulgarian Firms: Structure**

Number of firms by firm size 2008-2010 (non-financial enterprises)

- Up to 9 employees: 49%
- 10 - 49 employees: 24%
- 50 - 249 employees: 23%
- 250+ employees: 4%

**Source:** National Statistical Institute of Bulgaria

**Figure 2.2: Bulgarian Firms: Employment by size**

# of employees by size 2008-2010 (non-financial enterprises)

- Up to 9 employees: 29%
- 10 - 49 employees: 24%
- 50 - 249 employees: 23%
- 250+ employees: 24%

**Source:** National Statistical Institute of Bulgaria
2.5. While the innovative capacity of Bulgarian firms has improved relative to the EU since the Operational Program of Competitiveness was launched in 2007, following EU accession, the overall picture is still one of significant under-achievement (Table 2.1). 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 0.76 percent. 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

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business R&amp;D expenditures</td>
<td>9.4%</td>
<td>24.4%</td>
</tr>
<tr>
<td>Public R&amp;D expenditures</td>
<td>58.5%</td>
<td>39.5%</td>
</tr>
</tbody>
</table>

Source: EC Innovation Union Scoreboard 2011; author’s calculations.

2.6. 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.

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25Based on www. ec.europa.eu/eurostat
(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-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 chains. 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.

Figure 2.5: High-tech manufacturing exports (% of total)

Figure 2.6: Evolution of EXPY

Source: World Development Indicators

Source: Authors’ calculations, based on UN COMTRADE

2.7. 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 a 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).

Table 2.2: Patents granted by USPTO (per million inhabitants)

<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>

Table 2.3: Patents granted by EPO (per million inhabitants)

<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: Authors’ calculations, based on UN COMTRADE
C. Addressing market failures

2.7. 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

2.8. Innovation is an example of a public good – 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 incentive to produce at a level that would be optimal for society because: (a) it requires 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 is only partially able to be codified; therefore, it becomes mostly embedded in human capital, which is difficult to appropriate. In an open economy such as Bulgaria’s, the appropriation issue is even more serious, as it has further undercut the incentive to invest in new activities and has led to significant underinvestment in research and innovation across the economy. 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

2.9. 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


\textsuperscript{28}Sabel, C. (2012) Self-Discovery as a Coordination Problem. Edited by E. Fernandez.
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 a low-performance equilibrium. In such cases, the state could play a catalytic role in moving the economy to 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

2.10. 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 (Figure 2.7) in the absence of an active venture capital sector.

Figure 2.7: The commercialization process

2.11. The intangible nature of technological innovation and the uncertainty regarding their results make SMEs very difficult to finance due to the fact that 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 minimizes 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. 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

2.12. 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.

2.13. 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. Despite these measures have reduced unlawful appropriation of IP, their implementation remains uneven, and they have failed to spur indigenous innovative activity.

2.14. Despite the sound regulatory framework, the IPR system in Bulgaria remains largely unused by entrepreneurs and academics, due in part to the costs and complexity of the Bulgarian and European patenting processes. 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 valuable intellectual property, lack the

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30 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.
framework and experience to properly control and manage their innovations. Formal rules are, however, beginning to be adopted.

2.15. 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.

2.16. 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 leverage (see Box 2.1). 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 2.2).

Box 2.1: 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 follow-up R&D and innovation and ultimately discourage businesses to engage in R&D and innovation activities and also the originator of the patent to further R&D and innovation 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 and 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 2.2: 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
2.17. 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.

2.18. 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.

2.19. 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.

31 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).
b) Technology Road-mapping

2.20. 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.

2.21. 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 for a series of sessions 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.

2.22. 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 2.3: Technology Road-mapping (TRM) – Case studies and lessons learned

USA
The United States Department of Energy (US DoE), engaged in a Technology Road Mapping for 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 programmes 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 up front is crucial, involve decision-makers (within companies) throughout the process essential: 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.
2.23. 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.

3. **Innovation Funding Instruments**

2.24. 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 make 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.

<table>
<thead>
<tr>
<th>Year</th>
<th>Failure Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>25%</td>
</tr>
<tr>
<td>Year 2</td>
<td>36%</td>
</tr>
<tr>
<td>Year 3</td>
<td>44%</td>
</tr>
<tr>
<td>Year 4</td>
<td>50%</td>
</tr>
<tr>
<td>Year 5</td>
<td>55%</td>
</tr>
<tr>
<td>Year 6</td>
<td>60%</td>
</tr>
<tr>
<td>Year 7</td>
<td>63%</td>
</tr>
<tr>
<td>Year 8</td>
<td>66%</td>
</tr>
</tbody>
</table>

Table 2.4: Failure of US Start-ups after One to Ten Years in Business

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2.25. 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.

2.26. 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 Box 2.4). 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 priorities and programs.

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 favours projects that comply with the procedure’s administrative criteria rather than project’s quality and innovative potential. Simplifying the process and

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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
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 OP IE 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 OP Innovation and Entrepreneurship to be developed for the 2014-2020 cycle (OPIE) is an opportunity to introduce new innovation instruments targeting various stages of the innovation value chain.** The OPIE 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) Mobile Industry Applications Labs that would provide the necessary infrastructure for the deployment and scaling up of mobile applications; (iv) A Network of Technology Transfer Offices with an off-campus office providing specialized services in research commercialization; (v) Programs promoting collaboration with Bulgaria’s highly skilled Diaspora that would result in connection to the global knowledge networks and innovation experts; (vi) Innovation Vouchers for SMEs that would encourage behavioral change in SMEs in traditional sectors towards innovation (see ).

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 OP IE. 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 2.5: Proposed menu of innovation instruments

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Rationale</th>
<th>Best practices</th>
</tr>
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</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 |
| Mobile Applications Lab                        | • Would further boost Bulgaria’s competitive advantage in the sector by providing an enabling environment for promising entrepreneurs and supporting the development of bottom-up innovation communities. | • The lab could be set up in partnership with private capital venture capitalists, local and international universities, technical colleges and business schools, industry leaders, including operators, device manufacturers and content providers. |
| Technology Transfer Office Network             | • Optimization of technology transfer services in a cost-effective way  
• 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. | • Having TTOs specialize in different areas to foster collaboration and contracting between TTOs |
| Diaspora                                        | • For a country with a significant | • Initiatives promoting |
collaboration program
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.
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.

Box 2.4: Bulgaria’s Operational Program on Competitiveness 2007-2013 (OPC)
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.

OPC Budget Allocation by the Priority Axes (PA) 2007-2013

Early stage and Venture capital funding

2.27. 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.

Figure 2.8: Stages of financing entrepreneurship

Source: Cardullo 1999.
IPO = Initial Public Offering

2.27. The recent EUR21 million acceleration and seed funding of privately managed funds Eleven and Launch Hub under the JEREMIE initiative using OPC funds is a most welcome development. However, 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 funds about jettisoning underperforming companies after a trial period; (v) an international outlook is required to ensure that companies are

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OECD 2006.
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 2.5), set the stage for the culture of innovation and the robust venture capital industry that prevails in the country.

Box 2.5: 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

c) Facilitating coordination - Sofia Tech

2.28. The proposed Sofia Tech Park could serve as the infrastructure vehicle to house all the coordination instruments outlined in Table 2.5. 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 Tech Park could go a long way toward reducing the system’s many coordination failures. As with incubators (Box 2.1), 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 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. 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.
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

Box A.1: The impact of Business Environment Reforms on New Firm Registration – Evidence from Bulgaria

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>
</tr>
</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 (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. The objective of this chapter is to analyze the challenges of developing a sound governance structure for the Bulgarian National Innovation Support System, and propose an institutional arrangement that accomplishes 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 that 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 to fine-tune strategic targets, policies, and the quality of implementation.

3.2. The ultimate goal is to put 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 state failures that are most prevalent in government intervention. Second, there is a review the alternative models of organizing the public innovation support system in OECD countries. The third section examines Bulgaria’s innovation system and explains why institutional reform is necessary. Finally, we describe the characteristic 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

3.3. 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 presents important challenges, the first of which is achieving a national consensus that innovation is a right path to economic growth. Then the state must have a broad and long-term vision to guide the development of the Innovation System through the 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 investment. Government’s role includes developing governance institutions, proper incentives, and mechanisms to correct for systemic and market failures that impede public and private efforts to help the country reach its full potential.
3.4. With progress will come more challenges. There will be interest groups – corporations, scientists, universities, entrepreneurs – that benefit from this support and will exert pressure for it to be maintained over time. In addition, a major institutional capacity building effort is needed to meet the requirements for full disbursement of the current European Framework Program funds, which expire in 2013. After that, Bulgaria faces the challenge of improving its institutional capacity to absorb and efficiently use the resources from the next EU financial period for the years 2014 to 2020.

3.5. 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 levels by the end of the decade.

How to Prevent State Failures

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

3.7. Dynamic inconsistency, which can also be called temporal incoherence, relates to an official’s or government’s difficulty in enforcing a course of action when benefits will only be realized after they leave office. Dynamic inconsistency is especially important because of the difficulty of measuring the impact of pro-innovation policies (see
3.9. Figure 3.1 for tools). 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 face of political changes. In the case of Bulgaria, the need to commit to the Framework Program of the European Union, which regulates Structural Funds, has in part solved the consistency issue.

3.10. Capture and rent seeking occur when a person or group manages to extract a particular benefit from a public instrument; for example, getting the state to finance activities that could have significant private return 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 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 always changing.

3.11. 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.

The Challenge of Governance

3.12. 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.
3.13. 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.

3.14. 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.

3.15. 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 a mainly 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 quite distinct task from the formulation of detailed policy and implementing 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.

3.16. It is also necessary to establish clear areas of responsibility for each of the multiple actors. This has often resulted in implementing agencies losing responsibility for defining policies, while gaining 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 this coordinating role, the capacities of these agencies are strengthened, and their increased focus on developing intelligence enables them to contribute their specific knowledge to those who make policy decisions. This generally results in better aligned programs, more complementarities, and less fragmentation and overlapping in program focus and resource allocation.

3.17. At the level of specific interventions, 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 (Table 3.1).

<table>
<thead>
<tr>
<th>Coordination tools</th>
<th>Horizontal coherence</th>
<th>Vertical coherence</th>
<th>Temporal coherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy frameworks</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Policy councils/platforms</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.1: Coordination tools and coherence
White Papers by Strategic Advisory Councils | X | X
State budgets | X |
Government committees | X | X |
Task forces | X | X |
Informal networks and negotiation | X |
Agency development | X |
Coordination with regions | X |
Performance contracts and monitoring systems | X | X | X |
Merging ministries | X |
Joint programs | X | X |


3.18. 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 have role in horizontal and vertical coordination. The latter could be enhanced by specialized implementing 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

3.19. 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 pillars.

3.20. 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.

Division of Labor Model

3.21. 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.

Dominant Player Model

3.22. 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.

3.23. 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, but is not responsible for policy decisions.

Pillars Model

3.24. 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.

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

- *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, helping to meet the principle of accountability.

3.26. 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 feedback and learning over time.

3.27. 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?

Governance of Bulgaria’s Innovation Support System

3.28. Innovation policy in Bulgaria follows the division of labor model; it is designed and implemented by multiple ministries and agencies, and has the fragmentation and coordination problems characteristic of that model. One effect has been to negatively affect 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 would not be able to develop a coherent approach to creating 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 under execution of existing programs, in particular with the EU Framework Programs, reduce temporal coherence, which prevents institutional development and the creation of capabilities in the public sector. Finally, as we will see vertical coherence and speedy execution have been tried to obtain by the Ministry of the Economy by integrating the Agency in charge of SMEs’ development, which will reduce effectiveness, transparency and accountability.

Box 3.1: Use of public funds for innovation

Most research programs are formulated by the Ministry of Education, Youth 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, Energy and Tourism mostly through the OP Competitiveness department and the almost inactive National Innovation Fund.

EU funded Operational Program (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 OPC relate to two specific objectives: (i) encouraging innovation and increasing the efficiency of enterprises and (ii) improving the business environment.

A of 9/21/2012 the disbursed rate of the EU funded Operational Program (OP) Competitiveness overall is 27.9 percent and the contracted rate is 55.6 percent. In particular, Axis 1 of OP Competitiveness, which supports business innovation, has a contracted rate of 2.53 percent and the contracted proportion is 44.8 percent. In particular, EU financing instruments supporting scientific research and innovation are designed and administered by different bodies, with limited coordination.
3.29. On the whole, the strategies and policy definitions for scientific research and advanced human capital formation have been developed independently of the strategies and policies for innovation, despite the fact that both are critical components of the innovation system. Further, the long time horizon for results seems to have reduced the incentives to improve governance in favor of short-term goals such as quick implementation of undisbursed programs.

3.30. Figure 3.1 depicts the organization of Bulgaria’s Innovation Governance System.
**Recent Institutional Developments**

3.31. The Ministry of Education, Youth and Science (MES) and the Ministry of Economy, Energy and Tourism (MEET) 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.

3.32. There are two formal mechanisms for coordinating innovation policy – the National Council for Innovation (NCI) for MEET, and the National Council for Scientific Research (NCSR) for MES. The NCI has far fewer decision-making powers than its counterpart at the Ministry of Education and Science, and serves only as an advisory body to the MEET, with very few meetings in the last few years and not formal written proposals or studies on innovation policy.

3.33. 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 MEET; it does not have its own budget or enabling legislation, and its influence as a coordination body is low. It is not involved in policy implementation, and it has no direct relationship with agencies in charge of implementing innovation programs. Although the Council was given new powers in 2011 to support the RIS3, it did not meet even once in 2012.

3.34. Formally, the mission of the National Council on Innovation, as a consultative unit to the Ministry of Economy and Energy, is to assist the implementation of the National Innovation Strategy by providing consultancy and analytical support.

3.35. 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; and development of the innovation policy and approves the measures needed in this area for the next reporting period. The Council is also expected to discuss draft laws related to the promotion of innovations in the country.

3.36. The National Council on Innovation has eleven members. It is chaired by the Minister of Economy, and includes one person from each of the following institutions: the MEE, the Ministry of Education and Sports (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.

3.37. 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.

3.38. 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.

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.

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

- Have participation from Academy, industry and other ministries
- They have their own law or are included in “innovation law”
- Most of them conduct their own studies
- They do have a secretariat of permanent employees
- All but one has attached working groups with stakeholders and Academia.
- All have reports to disseminate activities and establish position on key issues regarding development of innovation system in the country.
- Most councils are unique, in the sense that comprises innovation and Science and research, without a parallel one for the latter subject.
### Table 3.2: Cross-country comparison of Innovation Councils

<table>
<thead>
<tr>
<th>Country</th>
<th>Name</th>
<th>Established</th>
<th>First</th>
<th>Second</th>
<th>Membership</th>
<th>Other Ministers</th>
<th>Industry</th>
<th>Academics</th>
<th>Government</th>
<th>Mission/Turf</th>
<th>Reports</th>
<th>Authority/Role</th>
<th>Controls</th>
<th>Budgets</th>
<th>Studies</th>
<th>Influence</th>
<th>Secretariat</th>
<th>Consult/Advisories</th>
<th>Communications</th>
<th>Evaluation</th>
<th>Uniqueness</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Austrian Council</td>
<td>2000</td>
<td>2001*</td>
<td>2001*</td>
<td>Pre-existing</td>
<td>Govt &amp; Industry</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Canada</td>
<td>Science, Technology and Innovation Council</td>
<td>1993</td>
<td>M/H</td>
<td>M/H</td>
<td>Pre-existing</td>
<td>Industrial Union</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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</tr>
<tr>
<td>Ireland</td>
<td>Innovation Council</td>
<td>2000</td>
<td>2001*</td>
<td>2001*</td>
<td>Pre-existing</td>
<td>Govt &amp; Industry</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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</tr>
<tr>
<td>Italy</td>
<td>Advisory Council for Science, Technology and Innovation Policy</td>
<td>2003</td>
<td>2003</td>
<td>2003</td>
<td>Pre-existing</td>
<td>Govt &amp; Industry</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>No</td>
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<tr>
<td>Japan</td>
<td>Council for Science and Technology</td>
<td>2005</td>
<td>2005</td>
<td>2005</td>
<td>Pre-existing</td>
<td>Govt &amp; Industry</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Netherlands</td>
<td>Council for Science and Technology</td>
<td>2001*</td>
<td>2001*</td>
<td>2001*</td>
<td>Pre-existing</td>
<td>Govt &amp; Industry</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Sweden</td>
<td>Government’s Council for Science and Technology</td>
<td>2002</td>
<td>2002</td>
<td>2002</td>
<td>Pre-existing</td>
<td>Govt &amp; Industry</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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</tr>
<tr>
<td>UK</td>
<td>National Council on Innovation</td>
<td>2006</td>
<td>2006</td>
<td>2006</td>
<td>Pre-existing</td>
<td>Govt &amp; Industry</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>No</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Bulgarian Council for Innovation</td>
<td>2003</td>
<td>2003</td>
<td>2003</td>
<td>Pre-existing</td>
<td>Govt &amp; Industry</td>
<td>Yes</td>
<td>Yes</td>
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</table>

Source: OECD 2005 and own author’s elaboration.

#### 3.41. Second-generation innovation councils are of two main types: strategic/intelligence/advisory, and coordination. The different roles of advisory and coordination councils are discussed in the next section.
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 (}
3.43. Table 3.2) 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.

3.44. 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.

**Coordination Councils**

3.45. In the countries with a division of labor model, it is very challenging to have 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 ensure 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 policymaking 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:

3.46. The chairman of the Finnish Science and Technology Policy 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.

3.47. 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 is very active in proposing projects or new instruments oriented to solve problems in the Innovation
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).

3.48. The Council for Science and Technology of the UK advise the prime minister and also play a coordination role across ministries when comes to defining innovation policies that requires to have consistent science, technology and research policy. The Chief Scientist (Chief Scientific Advisor) co-chairs the Council with a private sector representative.

3.49. 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.

3.50. 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 OCDE in 2010, has been very active in institutional development in the 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 in 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 detail 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. With the change in government coalition the Ministerial Innovation Committee has become strengthened and the council weakened. The significant independence reached by the Council in the previous government was perceived as dysfunctional for the implementation of a new government agenda in innovation. This has resulted in a transformation of the council in an advisory board in a limited area, where the government is willing to be advised. 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 the Economy, with the participation of the Minister of Education and several sector ministries. Also include the participation of the President and Vice President of the Advisory Board, All of this establish by law with clearly define mandates.

**Governance Principles**

3.51. 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) the 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:

  - Oversight 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 have 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. Designs are 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 Innovation Board, and The Innovation Advisory Council

Smart specialization means establishing priorities in research, technological infrastructure and advanced human capital, coordination and consistency over time with strategy are essentials ingredient for success. Of course the development of implementation capacity, creating strong agencies, agencies, with proper governance with clear mandates, oversight, and performance evaluation are a critical first step in the development of the Innovation system. A well-structured council could play also a also a key role in creating the momentum for the development of these agencies. The proposal consider consider first the creation of a standing alone Agency that would manage the innovation and business development programs with a proper corporate governance, that will generate focus and accountability accountability in implementation. In defining the Smart specialization strategy it is important to have a a process of consultation and dialogue with key stakeholders of Bulgarian Society. The goal is to have a 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. (See

3.52. Figure 3.2).

Figure 3.2: Proposed Innovation Support System Institutional Arrangement
How to Integrate Coordination and Advisory Roles

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 (See 3.53. Figure 3.2), a scheme that has worked in countries like The Netherlands and Chile.

The National Innovation Board (NIB) will act as a coordination body. In addition to coordinating the innovation and research agenda the NIB, through its secretariat, would also monitor and evaluate the innovation policies and strategies of the different agencies, and provide feedback for learning (3.54. Figure 3.3). The NIB will also make sure that issues considered in the 6 Regional strategies are taken into account in the National RIS3 strategy.

The Innovation Advisory Council, comprising stakeholders and experts, would focus on long-term strategic issues. The Advisory Council will have a small secretariat (see...
3.55. Figure 3.3). This would strengthen its independence and capacity to define its own agenda and will increase influence on the NIB. The Innovation Advisory Council will not be subordinated to the NIB. This institutional arrangement would allow the NIB to play an effective coordination and policy role, while the Advisory Council would ensure the continuity of strategic advice and intelligence.

3.56. This institutional design should guard against a situation such as the Netherlands, where significant overlapping between the advisory and coordination council, 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 NIB, will improve communication between these entities and enhance accountability for policy coordination and implementation.

Members of the NIB and Innovation Advisory Council

3.57. The members of the NIB would represent all sectors relevant to the innovation and research agenda. The NIB 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 NIB would also include the following members of the 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 NIB 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 Advisory Council members can only have voice in the NIB and not voting rights.

3.58. The goal of the participation of relevant members of the advisory council is for enhancing coherence between the Strategic long term view of the council and short term policy agenda of the NIB. It attempt to reduce time inconsistency of the government. It also prevent that the advisory council be made irrelevant by the government, since it is required by law to give its opinion on policy issues from a long term perspective.

The NIB would have a technical secretary with high professional capabilities and an executive secretary. NIB staff should have competencies in public policy, impact assessment, econometrics, innovation, research, and human capital policy.

3.59. Figure 3.3).

3.60. The secretariat of the Innovation Advisory Council will include a minimum staff of two or three professionals (Figure 3.3). The secretariat’s role would be to produce/contract out position
papers and studies, as well as the organization of events for their dissemination. This secretariat will strengthen the advisory council’s independence to define its own agenda and will increase influence on the NIB.

3.61. The independence and impartial stance of the advisory council 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 NIB and Advisory Council

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
- Lengthens the decision-making process
NIB legal status

3.62. First, the NIB will replace the two existing councils (NCI and NCSR) and would be a state agency attached to the Council of Ministers (COM) and could have ministry status. Ideally, the NIB 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 NIB to an appropriate level of funding, including for a secretariat.

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

3.64. The fast track alternative to this option would be adopting the governance mechanism by way of COM regulation (submitted by the Minister of MEET). 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.

3.65. Second, while the NIB 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 Minister are members of the NIB, it is highly likely that the agencies’ heads of would consider and implement the decisions of the NIB.

3.66. Third, the participation of private sector and all non-public officials in general, as NIB members, depend on the Executive’s decision. The channel to mandate the involvement and participation of non-public officials in the NIB 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.

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

Monitoring Role of the NIB

3.68. The NIB 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 NIB to assess the efficiency and impact of the innovation programs. Ensuring proper functioning of the system will depend on three levels of evaluation\(^3^9\) (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.

![Figure 3.4: Monitoring of the Innovation System](image)

3.70. Since it is difficult to measure the progress of initiatives with a long maturation period, the NIB 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 NIB.

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) it 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 these 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 that implement innovation and research policies in Chile, 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)). This council 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 get published publicly.

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.

**NIB and Innovation Advisory Council Responsibilities**

3.72. The elaboration of the Smart Specialization Strategy presents an excellent opportunity to launch the NIB and the Advisory Council. The Advisory Council could play a role in establishing a space for consultation to achieve consensus and stakeholder buy-in regarding the Strategy, which the NIB could then formally approve it once the process is finalized. The NIB 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.

3.73. In the first phase of Strategy implementation, the NIB should work with the MEET 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 with various implementing agencies. The contracts, to be approved by the NIB, 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 NIB. 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. One of the most important achievements of the Chilean reform was to be able to have a coherent systemic allocation of resources consistent with the agreed strategy. When this was solved in a bilateral negotiation with the Minister of Finance, it was unlikely to end up with consistent budget allocation across areas. Establishing coherent budgetary priorities for the overall Innovation system is one of the important tasks of the proposed NIB.

**G. An Innovation Implementation Agency**

**The case for a specialized implementation agency**

3.75. In Bulgaria the implementation of programs funded by EU’s structural funds, specifically those under MEET’s OPC 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) The technical project evaluation process does not involve a sufficient number of evaluators with adequate technical and commercial experience.

3.76. 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 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.

3.77. 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 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.

Governments have a variety of ways to support innovation.

3.78. Figure 3.3 shows a comparison among nine implementation agencies in seven countries. All of them provide subsidies in a matching grant basis 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).

Table 3.3: Implementation Agencies – Types of Instruments Used

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3.79. The 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.

Guidelines and principles

3.80. 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 certain requirements that we address in what follows:

a. Clear definition of scope of action by NIB. One of the first tasks of the NIB should be to establish for the Implementation agencies a clear mandate, specifying the type of instruments and beneficiaries that 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 Agency in Charge of Business Development and Innovation. In addition, the National Research Fund should also be strengthened as a standing alone agency, with proper corporate governance, clear mandate, transparency and accountability. It is important to avoid duplication of instruments, since competition in providing subsidies create incentives for arbitration by beneficiaries among agencies. In grey areas proper coordination should be required.

b. Governance structure for each Agency. Each agency should have a board of directors responsible of oversee the functioning of the agency, appointing the CEO and approving the 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 the chairman of the Business Development and innovation agency and the Minister of Education of the National Research Board. The board should also be constituted of experts in the field, appointed by NIB. Also a representative of the Minister of Education and the CEO of the Agency in the research area should participate.

c. Advisory Committees for Programs. In programs where it is important to have an integrated assessment of proposals and expert evaluations, it would be important to have an advisory committee that will advise on projects selection and assessment of the functioning of the program. These committees should be integrated by businessmen, innovation experts and scientists.

d. Selection of CEO. The best option is that the selection of the CEO of the agency is done by the board as a whole, with a public process base on merit and with a clear job description.

e. 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 NIB. In these contracts there would be the criteria for the detail design of the instruments, the deadlines, the amount of resources that should be allocated, the type of evaluation in each stage, and also outcome indicators that are obtained from impact assessment evaluation of the program.

f. **Performance contract for implementing agency (ies).** This would be a comprehensive Performance Contract for the overall agency (ies) in terms of its effectiveness of reaching the intended beneficiaries, fulfilling its mission, etc. It will make reference to improving the performance of the specific programs while taking into account its complementarities and the contribution of the agency to the fulfillment and alignment to the RIS3.


g. **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 NIB for agreeing on evaluation methodology. The formal opinion of The Innovation Advisory Council is also advisable.

h. **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.

i. **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. Clusters do not respect regional boundaries, therefore building a shared macro regional vision regarding cluster development is important for solving coordination failures and strategic creation of capabilities for generating clusters innovation dynamics.
Chapter 4 – Research

A. Introduction

4.1 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, Bulgaria has an unparalleled opportunity to transform itself into a knowledge-based and R&D-led economy by excelling in research and science. 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.

4.2 The overall goal of government is to manage research and innovation as a system that will generate the greatest possible return to the community in the form of economic, social, and environmental benefits. Figure 4.1 presents the transmission channels that connect the inputs, outputs, and outcomes of the research system. A key aspect of this system is that final research outcomes are a product of not only research outputs, but also the processes by which the outputs are diffused, adopted, and translated by users of this new knowledge. The system is not linear; it involves complex linkages and feedback loops.

Figure 4.1: Tracing the Impact of the Research System – from Research Inputs to Outcomes

4.3 Bulgaria’s challenge is to turn its research system into an engine of innovation and smart specialization. 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 spending of 0.5 percent of GDP in real terms over the 3S period, in order to match the expected level of private R&D. Part of this increase can come from improved absorption of future EU funds earmarked for innovation. The rest would need to come from a boost in national budgetary funds. In this context, it is vital to improve the financing mechanisms to achieve better
results, and to implement coordinated reforms on several fronts to reverse the decline in scientific productivity and increase the impact of public investments on basic and applied research.

4.4 This chapter presents a global benchmarking of Bulgaria's research performance and a detailed diagnosis of the strengths and weaknesses of the research system, with short term and long-term recommendations. The recommended policy actions cover five critical areas: (a) how to improve the organization of the system, including a proposal on how to advance the restructuring the BAS institutes and universities; (b) mechanisms that could be used 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 implementation could be strengthened, with a focus on the National Science Fund; (d) changes needed 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. Implementing a comprehensive package of reforms would have a major effect on the performance of the research system and lay the groundwork for implementing the future OP Science and Education 2014-2020.

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 to make public investments in research to increase their global competitiveness.

Where does scientific research fit in the innovation ecosystem

4.6 Scientific-based innovation is important from a growth and social perspective. Science has a central role in terms of 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. Scientific innovation involves the successful exploitation of new ideas to generate new techniques, products and processes.”

From a broad innovation ecosystem perspective, scientific research is also central for building a country’s innovative capacity and absorptive capacity. Figure 4.2 gives an overview of the main benefits and impact that flow from research activities.

Figure 4.2: Impact of Science


40 Conway, Waage, Delaney (2010), Science and Innovation for Development. UK Collaborative on Development Sciences (UKCDS), 2010
4.7 Research systems involve a diverse system of actors and institutions. Governments have a critical role when it comes to financing basic research because the knowledge generated gets disclosed after it is published and becomes a “public good” – this means that private sector will invest less than is socially optimal. Government entities sometimes perform the research, as in the case of the National Laboratories in the US, but the bulk of internationally recognized research is carried out in universities. At the same time, firms play a key role in translating scientific research into profitable inventions – 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.

Box 4.1: Defining science and R&D

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, 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 [4].

Sources:


4.8 The commercialization of research results is critical to realize the full benefits from the public research system. Knowledge transfer can go in both directions: the “supply-push” model is when knowledge generated in the research system is commercialized through IPR, technology transfer and spin-offs; and the “demand-pull” model refers to the case when companies get support from
Researchers through contract research and collaborative R&D (see Figure 4.3). Knowledge generated by the “public research system is diffused through a variety of channels – mobility of academic staff, scientific publications, conferences, contract research with industry and the licensing of university inventions” 41.

**Figure 4.3: Knowledge Transfer Models for Commercialization of Public Research**

- **Supply-push model**: sale, technology transfer, licensing, academic spin-offs
- **Demand-pull model**: contract research or collaborative Research and Development (R&D)

*Source:* visualization based on the OECD STI Outlook 2012

**Global trends in science and what they mean for emerging countries**

4.9 Global science is evolving at an increasingly fast pace as emerging countries, particularly China, continue to invest heavily in R&D to catch up with developed economies. The pace of knowledge creation is accelerating and the scientific frontier is rapidly shifting. This creates competitive pressures for both advanced and developing countries alike. The competition has become so intense that countries need to move forward just to remain in the same relative position. This also means that countries without a strong national research system risk being unable to absorb or economically benefit from much of this knowledge developed worldwide.

4.10 The EU continues to be a global leader when it comes to scientific research, but there are signs that the continent is slipping behind. European countries had the undisputed leadership in science up to the 19th century, but in the 20th century the United States leapfrogged ahead, and emerging countries have significantly closed the gap in recent decades. 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”. Recent assessments by the Royal Academy and other institutions coincide that Europe’s position in science is being eroded (Figure 4.4).

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41OECD Science, Technology and Innovation Outlook 2012.
4.11 At the same time, the global map of scientific research is becoming increasingly multidisciplinary. Figure 4.5 depicts the network of connections among disciplines, based on cross-citations in journals in 2007, using new data mining tools and comprehensive data from the Science Citation Index and the Social Science Citations Index. The network evidences the enormous complexity and cross-disciplinary character of current scientific research at the global level. Some fields, such as mathematics, are so interwoven throughout the research system that they have no single label. Innovation usually occurs at the margin or intersection of disciplines.

Source: Innovation Union Competitiveness Report 2011

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4.12 Responding to this changing environment, governments in OECD as well as emerging countries are introducing reforms to overhaul the incentive systems inside universities and PROs. During the past several years, the incentives system has been changing in terms of: (i) increased incentives to publish; (ii) changes in the reward system; and (iii) increased reliance by governments and communities on universities and institutes as a source of economic growth. 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 information 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.43

4.13 Large developed economies like the US and Germany can afford to follow a ‘science-push’ approach, whereas emerging countries need a more targeted approach to appropriate the benefits. In the case of emerging countries, there will be more benefits from their R&D effort if they follow a more targeted approach that emphasizes mission-oriented research. Many countries have invested important resources in research-oriented agenda to solve national problems in health, defense and environment. This research is performed mainly in public research centers but it has also created significant spillovers to business development.

4.14 A strategy of catching up by technology transfer, reverse engineering, coping and technology adaptation has been followed by many middle-income countries. Japan is the most well-known

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example until the 70s. Recently examples like Chile, with US$ 4,000 per capita in 1985, reached US$ 10,000 in 1995 in PPP just by technology transfer and adaptation in aquaculture, wine, fruit, positioning among the world leaders in all these activities. The challenges of enhancing productivity in these sectors go hand in hand with the mission-oriented research that the country undertakes. Countries that do not strengthen their domestic research system also risk losing the spillovers from knowledge developed worldwide.

4.15 Emphasizing mission-oriented research and technology transfer does not mean abandoning curiosity-driven basic research undertaken only on the basis of excellence altogether. Basic research still plays an important role in the research and innovation system: (i) academic careers are more attractive when the resources for research are available based on excellence, especially in countries that face a brain drain; (ii) it facilitates the connection of the local research community with international world class research groups; (iii) it provides a strong basis for the formation of advanced human capital; finally (iv) since the process of innovation is not a linear one, in order to progress many technology developments require a deeper understanding of the basic science behind the technology.

4.16 However, for basic research to benefit emerging countries with limited resources, the research needs to be conducted in institutions that foster excellence and collaboration. This requires developing institutions and incentives for science-push and demand-pull R&D, promoting models of open innovation in firms and the ability of research groups to respond to these demands. In smaller countries, independent basic curiosity-driven research groups that are disconnected from human capital formation should only be supported in exceptional cases and only when the center reached outstanding international recognition for its excellence.

4.17 The overall level of R&D in emerging countries is a critical factor for incorporating knowledge into production and moving into a more knowledge-based economy. The level of R&D investment correlates with higher income levels. Nevertheless, countries invest in R&D not because they are in the high-income group, but on the opposite, countries become rich because of the investment in R&D. At the lower level of development the composition of investment in R&D is skewed toward government-financed and developed R&D. As a country progresses, the private sector increases its absorption capability and take the lead in R&D, increasing the impact of R&D in production. Nevertheless, this shift it is not automatic, it requires the development of an institutional setting to promote and facilitate the involvement of private sector in R&D.

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

4.18 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 of Bulgaria’s “knowledge economy”, the benchmarking covers standard indicators to identify trends for 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.
4.19 Relative to many emerging countries, Bulgaria made limited progress in becoming a knowledge economy. The Knowledge Economy Index (KEI) suggests that Bulgaria has struggled to maintain its global position on R&D indicators in the post-1990 period. Figure 4.6 shows that Bulgaria continues to lag behind Europe and Central Asia. More worryingly, Bulgaria’s position has declined in the 1995-2012 period. In Figure 4.7 the aggregate Knowledge Economy Index (KEI) score is comprised of different pillars (weighted scores), where we can see that Bulgaria’s overall knowledge readiness in absolute values is below comparator countries, with the quality of education being the weakest pillar.

4.20 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, but it will fall below this level if the contractionary trends continue. In absolute terms, Bulgaria’s pool of researchers has contracted over the last decade, but as the size of the population fell during this period, the number of researchers per capita has remained approximately stable. The number of researchers is above or equal to what would be expected given the country’s income levels and global trends (Figure 4.8). If the contraction in the number of researchers employed continues once economic growth recovers, there is a danger that the size of the research system will become “too small” relative to the size of the economy. This would be in contrast with most Central and Eastern countries in the EU, which have increased science funding as GDP increased.

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Notes: (i) Countries located below the 45 degree line have backslid their position in the KEI during 1995-2012, while those above the line saw an improvement; (ii) Knowledge economy variables benchmark performance of 128 countries. Variables are normalized from 0 (worst) to 10 (best), weighted by population (retrieved January 2013).

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44 The World Bank’s Knowledge Assessment Methodology (KAM 2012) consists of 148 structural and qualitative variables in the following pillars: Economic Incentive and Institutional Regime, Education, Innovation, and Information and Communications Technologies (ICT). The KEI is intended to track the country’s overall progress towards becoming a knowledge economy. For details see: http://siteresources.worldbank.org/INTUNIKAM/Resources/2012.pdf.
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.

4.21 Scientific productivity remains well below EU levels, although it improved slightly as measured by the quantity of scientific publications in ranked journals. Bulgaria’s scientific productivity improved in absolute terms 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 (Figure 4.9). While other countries experienced a jump in scientific output in line with or above their economic growth trends, Bulgaria did not. At the same time, the contraction in public research funding that started with the 2009 fiscal consolidation is starting to have a visible impact on scientific production.
4.22 The average quality of research is also lagging behind as measured by citations to papers written by Bulgarian scientists. In addition to looking at the volume of research, it is important to measure its quality. One proxy for quality is the number of times that scientific papers written by Bulgaria researchers are cited by other researchers. By this measure, Bulgaria is comparable to countries in Central and Eastern Europe, but far below Italy, Finland, and the EU as a whole. Similar results emerge through the lens of the *H-index* developed by Jorge E. Hirsch.\(^{45}\) This indicator suggests that only a small share of research produced in Bulgaria has a significant impact in terms of knowledge creation and diffusion: Bulgaria’s *H* index is 129, meaning that in the 15-year timeframe between 1996-2011 only 129 publications generated at least 129 citations, which is far below other EU countries.

4.23 Bulgaria’s research system is mainly active in basic research, with scarce results from 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). The ratio of published articles to patents is a useful 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. While basic research is absolutely critical and should not be disregarded, it is important to put in place a system that also encourages applied research. As the next section discusses, elements of this system are gradually being introduced.

### 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>
<tr>
<td>Croatia</td>
<td>47,854</td>
<td>260,491</td>
<td>6.26</td>
<td>132</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>40,059</td>
<td>283,100</td>
<td>7.57</td>
<td>129</td>
</tr>
</tbody>
</table>

*Source: SCImago based on SCOPUS data, accessed December 2012.*

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

<table>
<thead>
<tr>
<th>Country</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>


\(^{45}\) This 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.
4.24 The country’s scientific specialization did not change significantly over time, as measured by publications in individual scientific fields, although the R&D allocation by field is shifting. There are different ways to measure scientific specialization. From the point of view of 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 that there have been increasing resources deployed towards medical and health sciences, whereas funding for agriculture research has dropped. (See the figures in Annex 4.1). The inflow of R&D to each field can vary from year to year because of investments in research infrastructure, but the base financing goes to pay for researcher salaries and there are negligible funds available to nurture research. This leads to the continuation of research agendas, with weak responses to demand-side changes.

Commercialization of research is a key weakness of Bulgaria’s research system, with poor results across results across all indicators. As shown in

4.25 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. Another indicator that commercialization in Bulgaria is still limited is that almost no new EPO or USPTO patents have been granted to researchers working in PROs. According to USPTO statistics, only five patents have been granted to Bulgarian inventors working for universities abroad over the past 10 years, and none to inventors working for universities in Bulgaria. Finally, there are no documented examples of spin-off ventures from PROs that have grown to become medium or large companies. While young people are creating high-tech enterprises, they are not connected to the research institutions and universities.

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46 2012 data includes a range January 1, 2012 - December 7, 2012.
47 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.
48 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 Collaboration 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 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.
4.26 Figure 4.11). As we discuss below, there is a huge potential to increase the relevance and quality of science in Bulgaria by further intensifying the cooperation with EU and global institutions.  

49 According to SCImago, Eastern Europe region encompasses 23 countries, listed online: http://www.scimagojr.com/countrysearch.php?region=Eastern Europe (Bouvet Island is excluded) 

50 According to the Erawatch, “the Ministry of Education, Youth 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 (MEYS data). The Bulgarian Academy of Sciences has also concluded 37 bilateral agreements, including seven countries outside Europe.”
4.27 Co-publication indicators show that Bulgarian researchers are becoming more tightly integrated into the ERA, a very positive development. Importantly, Bulgaria’s main partners for science are increasingly from high-performing EU countries. The trend during 2001-2009 shows that the pattern of Bulgaria’s scientific collaboration has shifted and now the top international scientific collaborators for Bulgaria are Germany, USA, France and Italy (Annex 4.1). This suggests that Bulgarian researchers are taking advantage of the proximity to excellent European institutions, which over time can lead to projects which have better visibility in the scientific community and help to refocus the research agenda on questions that are at the frontiers of science.

Figure 4.11: Percentage of published documents with more than one country

Source: SCImago based on SCOPUS, December 2012

D. Diagnosis of the research system in Bulgaria

4.28 This section provides a diagnosis about critical policy areas for Bulgaria’s research system. The point of departure is that the weaknesses that the research system faced in 1990 have become more acute as a result of the poorly organized PROs, 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 it will take time to overcome structural problems.
4.29 Currently only a small number of Bulgaria’s public research organizations (PROs)\(^{51}\) are conducting research that meets international standards. According to the available assessments\(^{52}\) 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):

- **The top institutes of the BAS continue to lead basic research in many fields.** 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. 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.\(^{53}\)

- **The largest universities in Sofia are also active in 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).

<table>
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<tr>
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</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>14,839</td>
<td>18,685</td>
<td>21,340</td>
</tr>
</tbody>
</table>

*Source: Web of Science (accessed March, 2010).*

4.30 The other BAS research institutes and the rest of the universities fail to produce research that is internationally relevant, which in turns limits their access to competitive research funding. Since

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\(^{51}\) PROs are public entities, established by the Republic of Bulgaria or another public entity authorized by law, which execute R&D activities. They include all research-oriented organizations and higher education institutions that conduct publicly financed R&D or training.

\(^{52}\) European Science Foundation (ESF) and ALLEA (All European Academies), *Research at the Bulgarian Academy of Sciences*, in five volumes, 2009.

\(^{53}\) 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 Photoprocesses; the Institute of Molecular Biology; 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 Cyrillo-Methodian Research Centre.
research capacity is highly concentrated in the top institutes and universities, the majority of PROs have yet to develop a critical mass of research that can make an international contribution and successfully compete for national or EU funding. According to the register of the Ministry of Education, Youth and Science (MEYS), Bulgaria has 51 accredited higher education institutions (HEI),\(^{54}\) of which 71.1 percent are located in three cities – Sofia (44.2 percent), Plovdiv (17.3 percent), and Varna (9.6 percent) (see Annex 4.2). More than three-quarters percent of the active higher education institutions are not producing research at EU levels if excellence and correspond to “teaching universities”.

4.31 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).

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

**From 2007 to 2012, scientific research activities in BAS increased in the first three years and faced a steady decline in the last two years.** The number of publications (including not just ranked journal articles but also monographs and other national publications) reached 11,632 for 2008.\(^1\) Since then the numbers have shown a decline: 11,367, 10295, 10051 for 2009, 2010 and 2011 respectively.\(^{2,3,4}\) The highest number of publications was in humanities, followed by the biological sciences, earth sciences and physical sciences. 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 number of scientific and applied scientific projects shows a decline: 3,844, 3720, 3232 and 2938 in 2008, 2009, 2010 and 2011.\(^{1,2,3,4}\)

**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 institutional and project funding.

**From 2002-2009, the share of the projects with additional funding had grown compared to the total number of the projects developed at BAS and fell in 2010 and 2011.** In 2001 this share was 54 percent and in 2008 it was 69.3 percent.\(^1\) However, in 2010 and 2011 these numbers fell sharply.\(^{3,4}\) Figure below shows this trend. This is a symptom of the dependency of the BAS on budgetary resources. At the same time, the difficult economic environment has made it increasingly difficult to sign research contracts or provide technology services to the private sector.

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\(^{54}\) [http://www.mon.bg/left_menu/registers/vishe/registrar.html](http://www.mon.bg/left_menu/registers/vishe/registrar.html)
**BAS projects are focused on basic and early stage applied research.** As in previous years, in 2011 the research and development phase (fR and fD) 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 fT (technology transfer), fM (developments with high maturity) and fBDR (business-driven). See table below for details. Patenting data confirms these trends: in 2010, the total number of filed patent applications and applications in procedure by BAS units was 99 in 2010 compared to 63 in 2011. The economic downturn as well as the deleveraging have 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:**

4.32 The research capacity of universities in individual fields is being monitored through the Bulgarian University Ranking System (BURS). The rankings broadly confirm the findings of the bibliometric analysis, but they also reveal pockets of research excellence in applied fields in universities located outside of Sofia. 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). For industries that are regionally dispersed, local universities have a better score in research and science.

4.33 The BURS suggests that teaching outcomes and research outcomes are weakly correlated (Figure 4.12). An in-depth analysis of the relationship between teaching and research, categorizing the disciplines into sector-related fields (see the sectoral case studies for details), indicates discrepancies between the quality of teaching and the quality of research. There is a strong positive correlation between teaching and research in the pharmaceutical field. The correlation between teaching and

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55 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.
research is relatively strong yet negative in food processing. In ICT, the correlation is weak. There is no correlation between research and teaching in machinery and electronics.

Figure 4.12: Bulgarian University Rankings - Teaching vs. Research

4.34 The separation of research and teaching at the institutional level is a legacy of the system prior to 1990 that has a number of negative effects. It deprives undergraduate and graduate students of the benefits of early exposure to top-level research by, for example, bringing research findings and research tools into the classrooms and having more student participation in research projects. While the BAS plays a predominant role in research but did not have a role in teaching until very recently, many universities have yet to develop a critical mass of research in any discipline. As we discuss in the next section, an indicator of this imbalance is that a much smaller percentage of R&D is performed by higher education institutions than the EU average.

Public funding for research

4.35 There are several channels for public funding to reach researchers working in PROs. National budgetary funding for science is provided through: (a) subsidies to the Bulgarian Academy of Sciences and accredited public universities; (b) subsidies to line ministries that finance RDIs within their organization (the Agricultural Academy and the National Centre of Public Health Protection); and to the Ministry of Defense to finance defense-related research; (c) project funding allocated by MEYS to the National Science Fund (NSF), which is the main source of competitive project financing.

4.36 Compared to EU and emerging countries, research funding is low and is allocated mainly through institutional funding instead of competitive funding streams. PROs depend heavily on institutional funding from the national budget. The current level of funding only covers basic expenses such as research salaries. Annex 4.3 provides an assessment of the funding issues in

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56Erawatch Country Report Bulgaria 2011
universities and a breakdown of the income and expenses at the BAS is available in their annual reports. As discussed in the recommendations, diversification to competition-based financing mechanisms would be highly beneficial to incentivize research excellence and achieve the 2020 targets. But the reality on the ground is that project funding managed by NSF dropped in the last three years due to the fiscal austerity measures and as a result there have been no regular calls for proposals. The next section discusses the issues with the competitive funding window, which is deployed through the NSF.

4.37 The share of public R&D channeled to the higher education sector is well below EU levels. Public R&D funding going to universities was only 12 percent of the EU27 level in 2011, the lowest among the comparator countries (Figure 4.14). By comparison, the overall public R&D expenditure of Bulgaria was about 35 percent of the EU27 level. This is a reflection of how the research system is organized and the fact that BAS absorbs a large share of the science budget. Bringing research funding for higher education up to European levels would reinforce the overall research system.

4.38 The government has started to earmark additional research funding to universities, and it would be useful if the funding were scaled up to also promote research networks and collaboration. 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. 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 directed to research infrastructure and collaborative research projects that are jointly executed by BAS institutes, top universities, and teaching universities, to promote knowledge transfer and cross-fertilization of the teaching and research agendas.

4.39 In addition to national funding for science, there is a growing volume of international funding, primarily coming from the EU Framework Programmes. In 2011, a growing share of R&D funding in Bulgaria came from the European Framework Programmes for Research (FP7) and the Competitiveness and Innovation Framework Programme (CIP). But the volume of funding that Bulgaria’s researchers can obtain under these programs is 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, for instance, in the period 2007-2011 Bulgarian projects accounted

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Source: own calculations, Eurostat (accessed Dec 2012)

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58Public R&D is the sum of government and higher education sectors R&D expenditure
for only 0.22 percent of all funded projects, whereas the share of Bulgaria’s GDP to EU GDP is about 0.59 percent.

4.40 The government has proposed an Operational Program on Science and Education for Smart Growth, which could dramatically transform the funding environment starting in 2014. While limited up to now, some funding for research was 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. For now there is limited information about the size of the OP, its priorities, the instruments that will be used, or the specific delivery mechanism in the area of science. As the concept is developed, it will be important to focus on additionality (i.e., on channeling resources to stimulate the individual and institutional incentives to achieve scientific excellence and commercialize research) and effective coordination with other OPs. The recommendations concerning the funding approaches for national budget resources are highly relevant.

Implementation of scientific support instruments

4.41 According to current legislation, the National Science Fund (NSF) has a critical role to play in terms of designing, implementing and evaluating science funding. NSF is the main source of competitive research funds channeled from the national budget. It may also play a role in implementing the future OP for Science and Education, and for this reason it is critical that it has the right level of capacity, transparency and accountability.

The NSF budget and instruments

4.42 The NSF implements the national programs to support basic and applied research, particularly through competitive project funding. In 2012 it made grants totaling about 14 million leva per year, which covers only a small percentage of funding requests. In 2011, the NSF received about 1,100 project proposals totaling about 400 million leva, of which a quarter was considered to be of good quality by fund management. In 2008, there were 1,038 proposals submitted for funding; and in 2009, there were 1,050 proposals. There were no projects funded in 2010. Most applicants are from the Bulgarian Academy and state universities.\(^{59}\) Since 2008, 6,000 researchers participated in NSF-funded projects.

4.43 The main instruments of the NSF are competitions that vary by scientific area, implemented through different projects or programs. The NSF supports four 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.

\(^{59}\)NPR 2011-2015
4.44 The instruments deployed by the NSF have a number of shortcomings. First, the funding 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 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**

4.45 The Fund is managed by a director with a board composed of Bulgaria researchers and a dedicated staff. It operates the competitions with a number of standing and interim Expert Panels (EPs), also appointed by the Minister of Education and Science. 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.

4.46 The governance of the NSF has proven inadequate. The resignation by several NSF directors in the last few years in the face of researcher discontent is a symptom of the governance problems that exist within the agency. The overall governance issues of the research and innovation system are discussed in Chapter 3. With regards to the NSF, the key issues are: (a) past NSF directors have been senior academics that lack management experience; (b) there have been continued complaints about conflicts of interest, which have become more acute as the NSF funding declined and competition among institutions and research projects became more intense; (c) the management of the NSF has not put in place an adequate M&E framework, which has led to questions about the public efficiency of research funding.

**NSF project evaluation**

4.47 According to the internal statutes, each supported project is monitored by an 11-member evaluation committee comprising experts for different types of projects. The projects run for 24 to 36 months. During implementation, the evaluation committee collects information on their progress. Some projects continue to be monitored after completion, particularly if they are likely to lead to a patent or involve a substantial innovation. If a project results in a patent, NSF becomes a shareholder.

4.48 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 in 2006 identified weaknesses that persist today in the project selection process, particularly regarding the profile of evaluators, and the absence of monitoring and evaluation of the scientific results of these projects. There has been no impact evaluation or ex post assessment of the competitions funded under the recent calls for proposals. The recommendations section highlights areas for improvement that are critical for the NSF to efficiently administer higher levels of research funding.
4.49 Getting an advanced educational degree in Bulgaria does not result in a salary that is competitive relative to the EU, which discourages young people from starting PhDs. 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 has made Bulgarian doctorate holders much more dissatisfied with their salary according to Eurostat (Figure 4.16).

![Figure 4.15: Annual Earnings Based on Education Attainment in Euro, 2010](image1)

![Figure 4.16: Level of dissatisfaction of employed doctorate holders by reason (salary) (%), 2009](image2)


4.50 OECD data suggest that there is a premium to PhD holders who work in research, but this premium is mainly 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).

4.51 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)
4.51 At the same time, the promotion system inside PROs 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 publications in international journals. This system has demotivated scientists, 60 made it difficult to recruit young people into research careers, forced researchers to supplement their income with other activities, 61 and made it difficult for the PROs to enter into new research areas.

4.52 As a result of the wage 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, as it is leading to fast 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, 128 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. 62 This policy issue is discussed in more detail in the human

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60 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.

61 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.

62 Eurostat
capital chapter, which points out that emigration affects not only the highly skilled, but people of all education levels.

Box 4.3: A greying scientific community

The worsening 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

![Age structure chart]


Commercialization of research results

4.54 Fostering the transfer, exploitation, and commercialization of public research results is critical for Bulgaria’s research to generate substantial economic impacts. Technology transfer is a multi-dimensional process that continues after the scientific discovery and through final commercialization (licensing to established firms or creation of new company) (Figure 4.18). Knowledge and research generated by the public research system is diffused through a variety of channels – mobility of academic staff, scientific publications, conferences, contract research with industry, spin-offs and the licensing of university inventions. These channels are critical for research to translate into the development of commercial applications which bring in patent royalties, entrepreneurial start-ups that create high-skilled employment as well as the development of new products and processes in established companies that are competitive in global markets.
4.55 The policy focus in Bulgaria (as in other ECA countries) is on promoting knowledge transfer via the “supply-push” path to commercialization. Science policy and funding instruments in Bulgaria have been designed with the idea of the “supply-push” model, in which scientists are at the origin of the project, the main barrier is selling the new idea on the market and the technological sophistication and risks tends to be high to medium. In this context, the priority is to give giving 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.

4.56 Outside of the ICT industry, the absence of indigenous technological development limits the “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. After two decades in which no new technologies were protected by the EPO or the USPTO, patent applications have started to recover thanks to the growth of the ICT industry. However, because the new generation of patents is derived from the R&D activities of subsidiaries of global ICT leaders such as SAP and VMWare (Figure 4.19), there is a large technology gap between foreign entrants and domestic PROs, and this creates problems for collaboration. In the other major industries, companies prefer to import modern machinery and equipment rather than invest in long-term technology development. Bulgaria’s technological specialization, proxied by patent applications in the period 1997-2011, is shown in Figure 4.20.

\[\text{OECD Science, Technology and Innovation Outlook 2012.}\]
4.57 Bulgarian legislation in the area of IPR protection is in line with the EU framework, but the IPR system is detached from other policy initiatives fostering research and innovation. IPR legislation reflects in all significant areas the Directives of the European Union on copyright, computer programs, and the like. However, in Bulgaria as in other EU countries, IPR policy has traditionally been detached from innovation policy, SME policy, entrepreneurship policy, and science and technology policy. Specifically, the lack of coherent policies to encourage IPR disclosure, patenting, monetization, and royalty distribution impedes research commercialization by PROs.

4.58 In part, this is because the rules about IPR ownership that apply in scientific research projects limit collaboration between PROs and companies. The ownership of IPR derived from scientific research is different from one institution to another. The current rules applied by PROs are not always in line with international best practices, particularly when it comes to facilitating the transfer or sharing of IPR.

4.59 Bulgaria also lags behind in terms of integrating IPR issues into research and teaching. There are few resources available to facilitate access to the IPR system by researchers, entrepreneurs, and SMEs. 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 owners and managers of SMEs.

4.60 Several technology transfer offices have been established to incentivize commercialization of research, but the results to date have been limited. Almost all TTOs are located in higher education.
establishments and BAS institutes. The TTOs are creating awareness about the importance of technology transfer and research commercialization inside PROs, but final results have been weak due to the following challenges:

- Small size, fragmentation, and lack of coordination of the TTO network
- Lack of sufficient resources, including reliable financing
- Lack of clear IP policies
- Insufficient volume of research with commercial potential
- Legacy of distrust between private sector and research institutes
- Lack of skilled professionals in innovation management and commercialization

E. Policy developments and recommendations

4.61 Reversing the decline in scientific productivity and increasing the economic and social impact of public funding for science is a major policy challenge. The benchmarking of Bulgaria’s research system and review of its key institutional and funding aspects point to five interconnected objectives that need to be integrated into S3 priorities and be the focus of regular monitoring and evaluation:

- Establishing incentive systems that promote excellence
- Making scientific specialization responsive to the need for economic specialization
- Addressing institutional imbalances in the research system
- Making research careers more attractive and retaining talent
- Stepping up R&D, commercialization, and public-private cooperation.

4.62 The Smart Specialization Strategy has the potential to set in motion a comprehensive set of funding and institutional reforms that can move the country toward achieving these objectives. For Bulgaria to achieve its goal of becoming a competitive EU partner and a moderate innovator by 2020, sequenced and well-coordinated actions will be necessary. These actions will need to be embraced by

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64 The TTOs were mainly established under two programs: (a) 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 (b) after Bulgaria’s accession to the EU, under Operational Program Competitiveness, as part of the projects to support already established offices. The technology transfer offices which were established are as follows: Sofia University; Ruse University; Naval Academy, Varna; Technical University, Gabrovo; Prof. Dr. Asen Zlatarov University, Bourgas; Agricultural University, Plovdiv; Maritsa Vegetable Crops Research Institute, Plovdiv; Institute of General and Inorganic Chemistry, BAS; Space Research and Technology Institute, BAS. The support for establishing new and/or expanding existing TTOs continued under the OP Competitiveness. Two financial schemes were opened in the period 2007 – 2012. A total of 21 projects worth BGN 8,417,366 in all have been approved for financing, or 86% of the procedure. Grant intensity amounts to 63%. To date, no funds have actually been paid under concluded contracts.
system stakeholders and aligned with commitments at the heart of both the National Strategy of Scientific Research to 2020\(^{65}\) and the Smart Specialization Strategy.

4.63 This section gives an overview of recent efforts to increase scientific productivity and the impact of public funding for science, with a focus on adoption of the National Strategy of Scientific Research. It then provides recommendations in each of the areas covered by the diagnosis—organization of research, public funding for research, the implementation of support instruments, academic careers, and commercialization of research.

**Directions set out by Bulgaria’s new National Strategy of Scientific Research to 2020**

4.64 In 2011, the Government of Bulgaria adopted the National Strategy of Scientific Research to 2020 (NSSR) after several earlier versions of the strategy failed to be ratified. The NSSR is aligned with the Europe 2020 Strategy and Bulgaria’s National Reform Programme, advancing research policy in the following areas:

a. **Identifies specific “pre-conditions for Bulgaria to attain the full benefits of integration into the ERA,” namely improving the institutional and policy framework, increasing R&D investments to 1.5 percent of GDP, and strengthening the capacity of public research organizations and private companies.”** Specific policy objectives under the NSSR include:

   • **Concentration of public resources and investment in priority scientific areas.** National instruments such as the National Science Fund and the National Innovation Fund are expected to play a central role in allocating funding to projects on a competitive basis. EU funds will play an essential role in incentivizing business to carry out R&D.
   
   • **Support for scientific infrastructure.** The strategy proposes to strengthen public research organizations by directing EU funds toward refurbishing laboratories, upgrading scientific instruments, and procuring research materials.
   
   • **Coordination with the private sector.** The strategy includes the development of mechanisms such as national technological platforms that can coordinate scientific and industrial interests.
   
   • **Mobility of human capital, knowledge, and technologies.** The strategy will support scholarships for doctoral students and increased mobility between Bulgarian and foreign research centers.

b. **Establishes priority areas that will be given additional support.** The NSSR sets out five priority areas that are expected to have high economic and social impacts (see Box 4.4). These five areas would receive 70 percent of the national R&D financing.

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Box 4.4: Scientific research priorities

The Science Development Strategy identifies five priority areas of research:

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 programme and competitive principle to the amount of 15 percent of the public expenses on science.

Information and communication technologies will be developed as a cross-cutting area that affects all spheres of life and economy.

These priorities were defined based on:

- An analysis of the scientific activity in Bulgaria;
- Economic analysis and export potential analysis performed with the support of the World Bank;
- The EU’s scientific priorities and the Aho report “Creating an Innovative Europe”;
- Areas with a high level of foreign direct investment;
- The priority areas of the Seventh Framework Programme for Research and Technological Development (FP7);
- The recognized need to promote applied research.

Source: NSSR.

c. Strengthens the monitoring and evaluation framework. 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; the number of Bulgarian consortia participating in European research programs, initiatives, and networks. See NSSR for details of the M&E framework.

Recommendations by policy area

Organization of research

4.65 Increasing the effectiveness and impact of the research system requires new policies that address the imbalances in how the system is organized. As discussed above, there are a number of imbalances in Bulgaria’s research system that need to be addressed: (a) the system is biased toward basic research, which by its nature has limited applications; (b) there are weak synergies between research and teaching activities—the institutes of the Bulgarian Academy of Sciences focus mainly on research, whereas universities lack a critical mass of research capacity; and (c) high-quality research

67 Bulgaria’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 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.
is conducted almost exclusively in Sofia. Since advantages from research tend to accumulate over time, this imbalance is inhibiting other regions from developing knowledge-based economic activities.

4.66 Changes in the governance of the research and innovation system and institutional reforms at the level of PROs are necessary ingredients to improve the performance of the research system. Chapter 2 highlights the need to reform the governance of the research and innovation system by setting up a National Innovation Board and an Advisory Council that can enhance coordination across line ministries and strengthen long-term policymaking capacity. It is critical to also begin the process of identifying, discussing, and agreeing on institutional reforms at the level of PROs.

4.67 There is a consensus that the organization of Bulgaria’s research system needs to be reformed to improve its effectiveness and impact, but there is no consensus about next steps. There have been calls to merge BAS institutes with universities to generate synergies between research and teaching, or to close underperforming institutes and universities that are absorbing fiscal resources. However, the academic community does not support either of these options due to perceived risks that this will lead to a loss of capacity and reduction in the number of research positions.

4.68 A first step toward resolving this issue would be to commission a system-wide independent evaluation to assess and rank all PROs. An independent evaluation by international experts would give policymakers and stakeholders a clear 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 a good framework for evaluating the scientific quality at the level of individual PROs, but this would need to be complemented by an in-depth assessment of system-wide organizational aspects, recruitment and promotion policies, and capacity to commercialize research and engage in public-private cooperation.

4.69 A second step would be to convene a high-level task force to discuss and agree on a roadmap to implement the recommendations of the independent experts. The task force could be chaired by the Minister of Education and include the management and top researchers of all PROs. 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. A recent World Bank assessment of RDI across the ECA region provides the following lessons for such an effort:

- 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 4.21 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 Fraunhofer.
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 4.21: RDI reform decision tree


4.70 The third step would be to initiate restructuring of PROs, taking care to mitigate restructuring risks that have been observed in other ECA countries. The restructuring would need to be done carefully, building on the lessons from the RDI assessment that are pertinent for Bulgaria. One important implication of those findings is that even a careful 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.

4.71 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 would attract more income from private sources. At the same time, the BAS and other institutes that are merged into universities would provide the basis for the creation of centers of excellence where support for R&I would be concentrated.

Public funding for research

4.72 Allocating more funding to research could have a major economic and development impact, provided the right funding mechanisms are used. As noted above, 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 S3 period if the ratio of public-to-private R&D spending remains at today’s level of 50 percent. Part of this increase will come from improved absorption of future EU funds earmarked for innovation. The rest would need to come from a boost in national budgetary funds. Directing additional funds to collaborative research projects, with a strong emphasis on mission-oriented research in priority areas (see Box 4.2), could have a major impact on the efficiency of public expenditures for science, and be a powerful incentive for high-quality research and collaboration.

4.73 On the basis of the foregoing diagnosis, it is recommended that future increases in institutional funding be made conditional on the PRO performance. Current levels of research funding are insufficient and excessively reliant on institutional base funding to BAS and universities. Tying funding increases to measurable improvements would create incentives for PROs to allocate resources to better performing research teams that can sustain improvements over time.

4.74 Ideally, the funding would be allocated on the basis of regular, independent monitoring and evaluation of each PRO’s performance. The funding provided through the UK Research Councils – the major source of public funding for research in the UK – is a good example of how to tie funding to regular independent assessments. The research assessment is carried out every five years. In the past, this assessment relied on expert panels, but the 2014 Research Excellence Framework will carry out a systematic benchmarking of research units that relies on impact metrics. Research funds will be distributed to university departments and laboratories based on the results of this assessment.

4.75 Funding could be allocated by matching the resources that PROs can secure from external sources. For this to work, the government would need to earmark public funding so it can be distributed on a first come-first served basis to PROs that match the external resources that each institution secures from private sources or EU sources such as the EU Framework Programmes. The matching could be at a 1:1 ratio, but the leverage effect could be greater depending on the available funds. The advantage of this scheme is that funds could be quickly disbursed, parameters can be easily be adjusted to take account of priority areas, and the resources would help to cover the costs of national co-financing for European projects. 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.

4.76 In parallel to the reforms in institutional funding, it would be advisable to scale up and maintain a stable level of competitive project funding. The resources allocated through competitive instruments administered by the National Science Fund (NSF) have been pro-cyclical. The recent economic downturn led to a sharp reduction in 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. In a project-centric approach, competitive funds would be disbursed to specific projects rather than institutions. Competitions can ensure better targeting of resources toward

68 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-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.
the best projects, make it easier to prioritize specific areas, and make funding more responsive to the 
demands of the business sector by specifying selection criteria. This is the approach favored by the 
NSF, but there are continuing problems in terms of instrument design, implementation, and 
evaluation.

4.77 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. 
Establishing a competitive system that gives national research fellowships to top researchers based on 
annual independent evaluations would be a good way to target scarce resources. As in other countries, 
the fellowships could cover basic research expenses, plus a stipend large enough to bring researchers’ 
salaries in line with those available in the EU labor market. This is discussed in more detail below.

Implementation of scientific support instruments

4.78 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. A key issue is how to establish what is considered mission-oriented research. The Innovation Advisory Council should play a role in identifying those 
scientific areas that are key for development of the national economy.

4.79 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 
effective co-financing from private companies or other public institutions that are interested 
in the result of the projects.

- Introducing a collaborative research 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.

4.80 Introducing new models for the acquisition of updated major scientific equipment would improve access among interested users and make possible a more balanced sharing of the costs. In many cases this equipment is associated with the research projects or programs and centers. Nevertheless, the experience shows that usually when the equipment is granted to narrow research groups, expensive equipment tends to remain underutilized. 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.

4.81 In addition to reviewing and refining the NSF instruments, the delivery mechanisms for science funding also need to be improved. The 2006 independent assessment of the NSF and more recent Arc Fund Innovation.bg reports point to a number of issues that need to be addressed:

- 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.
- 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.
- Calls or permanent Submission: 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.
- 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.
- 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.
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.

Academic careers

4.82 The priority should be to introduce a merit-based funding program to retain and attract top scientists as well as young researchers with clear potential. 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. Normally there are small grants for young researchers or post doc 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. Performance should consider not only scientific outputs, but also patenting and licensing. This approach is much more efficient than a blanket increase in researcher salaries.

4.83 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. 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. A similar system could be used to encourage the return of researchers from the Diaspora.

4.84 These grants are likely to have a bigger impact on the economy when they are given to the most promising researchers working in research centers with links to universities. When researchers work in universities that offer undergraduate and graduate programs in science, engineering, and technology, this can create a win-win situation. Researchers are able to attract research assistance as part of supervising graduate students on their thesis and research activities improve the quality and relevance of teaching.

Commercialization of research results

4.85 To foster greater R&D commercialization, policies that encourage IP disclosure, IP monetization, and public-private collaboration should be pursued. Many obstacles can emerge during the commercialization process, and the most important task for policymakers is to facilitate the necessary collaboration between researchers and industry. In Bulgaria, as in many countries, “the problem is not so much the [lack of] commercialization activity but whether the conditions for a

69 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.
massive and systemic (as opposed to rare and occasional) process of research commercialization are in place.”

4.86 Improving cooperation between R&D institutions and business will require a combination of demand-pull and scientific-push approaches. The demand-pull for research will come from the collaboration with and co-financing from business. Fostering collaborative contract research and the development of technology management capabilities in the business sector could strengthen cooperation. From the supply side, it is important to generate interface capacity that will promote both research contract agreements and the identification and protection of relevant IPR from the commercialization of research. Commercialization of research is catalyzed when policies:

- Establish a balance between supply-push (IP protection, licensing) and demand-pull (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.
- Deepen connections between R&D institutions and industry to promote more applied research. Such an approach would not only generate revenues for research institutions, but would enhance the market potential of the PhD students involved in such research.
- Enhance incentives to disclose and patent inventions. Full disclosure allows the academic community to continue to build on new knowledge.
- Give clear guidelines on IPR ownership and royalty sharing, to provide protection to the inventor, the PROs and the companies involved in collaborative research. The World Intellectual Property Organization (WIPO) has issued guidelines for universities and R&D organizations that can facilitate the process of commercializing IPR (see Box 4.5).
- 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.
- Allow for the use of IPR as collateral for financing activities, to spur entrepreneurship and help inventors procure early stage financing for their start-ups.
- Strengthen the TTO network. This would increase the number of patents issued by the USPO and the EPO; accelerate the transfer of research to the market; and give the academic community deeper insight into market needs and the existing IP landscape, thereby helping inventors to target their research more effectively. See details below.

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70 Correa, Paulo et al., Inception Report for Regional R&D Strategy for Innovation in the Western Balkan Countries, August 2011.
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

4.87 Given the current size and organization of Bulgaria’s research system, a central TTO that coordinates with local TTOs would be the best option for reinforcing commercialization activities. A centralized TTO could serve as a single technology commercialization window, as opposed to the current fragmented system, which provides no single mechanism by which academia and industry can engage effectively. The Engineering Portfolio of Inventions for Commercialization program at Stanford University is a good illustration of streamlined and efficient technology commercialization. The central TTO could include experts in IPR marketing, IPR landscape analysis, contract negotiations, and patent issues. 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.

4.88 A central TTO would also provide economies of scale. It could hire experts who typically command fairly high salaries, and purchase sophisticated databases for market and IP research that are

71 Stefani Shek, 2000, “Providing Industry with EPIC Access to Stanford's Engineering IP”, Stanford Technology Brainstorm. The EPIC Program, which stands for Engineering Portfolio of Inventions for Commercialization, is a licensing model housed in Stanford University (USA). Under the EPIC Program, companies pay a subscription fee and receive an option to fully-paid nonexclusive licenses, in a defined field of use, to all available technologies from the School of Engineering (exclusive licenses may be granted but they are negotiated separately).
out of reach of fragmented TTO networks. 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.

4.89 A well-functioning technology commercialization ecosystem would help to orient research in a direction that is more industrially relevant, thus getting superior returns on R&D investment. It would provide incentives for faculty and PhD students in the form of royalties from patent licensing, or ownership of start-ups arising from the research and develop entrepreneurial skills. Research institutes would generate additional revenues from royalties on patents and contract research and strengthen their linkages with global innovation chains.
Annex 4.1: Scientific publications

Annex 4.1a: Bulgaria's published articles in the peer-reviewed journals by field, per city, in relative terms (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 (%)


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

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<td>United States</td>
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<td>1061</td>
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<tr>
<td>France</td>
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<td>896</td>
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<tr>
<td>Italy</td>
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<td>715</td>
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<tr>
<td>England</td>
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Appendix 4.2: University rankings

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

<table>
<thead>
<tr>
<th>Industry and Discipline</th>
<th>University</th>
<th>Teaching</th>
<th>Science and learning</th>
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<tr>
<td><strong>Teaching</strong></td>
<td><strong>Science and learning</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Food processing</strong></td>
<td>University of Food Technology</td>
<td>50.13</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>Rousse University &quot;Angel Kanchev&quot;</td>
<td>67.88</td>
<td>36.71</td>
</tr>
<tr>
<td></td>
<td>Trakia University - Stara Zagora</td>
<td>50.3</td>
<td>54.41</td>
</tr>
<tr>
<td><strong>Plant Breeding</strong></td>
<td>Agricultural university</td>
<td>63.38</td>
<td>66.49</td>
</tr>
<tr>
<td><strong>Animal Breeding and reproduction</strong></td>
<td>Agricultural university</td>
<td>61.1</td>
<td>44.26</td>
</tr>
<tr>
<td><strong>Machinery and Electronics</strong></td>
<td>University of Chemical Technology and Metallurgy</td>
<td>81.41</td>
<td>74.53</td>
</tr>
<tr>
<td></td>
<td>Technical University of Sofia</td>
<td>62.66</td>
<td>81.64</td>
</tr>
<tr>
<td></td>
<td>Rousse University &quot;Angel Kanchev&quot;</td>
<td>63.6</td>
<td>44.3</td>
</tr>
<tr>
<td><strong>Mechanical Engineering</strong></td>
<td>Technical University of Sofia</td>
<td>56.24</td>
<td>85.29</td>
</tr>
<tr>
<td></td>
<td>Rousse University &quot;Angel Kanchev&quot;</td>
<td>72.71</td>
<td>47.43</td>
</tr>
<tr>
<td></td>
<td>Technical University of Gabrovo</td>
<td>69.12</td>
<td>50.78</td>
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<tr>
<td><strong>General Engineering</strong></td>
<td>Technical University of Sofia</td>
<td>71.21</td>
<td>84.53</td>
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<tr>
<td></td>
<td>University of Chemical Technology and Metallurgy</td>
<td>65.66</td>
<td>78.44</td>
</tr>
<tr>
<td></td>
<td>University of Mining and Geology &quot;St. Ivan Rislki&quot; - Sofia</td>
<td>35.61</td>
<td>49.25</td>
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<tr>
<td><strong>ICT</strong></td>
<td>Informatics</td>
<td>Sofia University &quot;St. KlimentOhridski&quot;</td>
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<td></td>
<td>American University in Bulgaria</td>
<td>55.04</td>
<td>44.18</td>
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<tr>
<td></td>
<td>New Bulgarian University</td>
<td>55.26</td>
<td>51.05</td>
</tr>
<tr>
<td><strong>Communication and computer science</strong></td>
<td>Technical University of Sofia</td>
<td>61.9</td>
<td>84.94</td>
</tr>
<tr>
<td></td>
<td>Technical University of Varna</td>
<td>60.69</td>
<td>59.36</td>
</tr>
<tr>
<td></td>
<td>Rousse University &quot;Angel Kanchev&quot;</td>
<td>65.86</td>
<td>61.1</td>
</tr>
<tr>
<td><strong>Pharmaceutical</strong></td>
<td>Biotechnology</td>
<td>Sofia University &quot;St. KlimentOhridski&quot;</td>
<td>58.56</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
Annex 4.3: Challenges in Allocating and Using STI Funding in Universities

In the case of universities, only a minimal amount is actually earmarked for research\textsuperscript{72}. 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.\textsuperscript{73}

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),\textsuperscript{*} 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.

\textsuperscript{* Article 91 (7)


\textsuperscript{72}World Bank (2012) Strengthening Higher Education in Bulgaria

\textsuperscript{73}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 4.4: 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

Annex 4.5: Bulgaria in FP7 - Key Facts

**FP7 Key facts and figures**

**Applications:**
As of 201/03/16, 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)
- Requesting EUR 494.62m of EC contribution (0.56% of EU-27)

Among the EU-27, Bulgaria (BG) ranks:
- 20th in terms of number of applicants 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 21.6%.
- 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 (16.6%) 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 201/03/16, Bulgaria (BG) participates in
- 292 signed grant agreements
- Involving 4,344 participants of which 385 (8.86%) 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, 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 18.26%.

Specifically,
- 926 BG SME applicants requesting EUR 151.91m
- 131 (14.15%) successful SMEs requesting EUR 19.43m (12.80%)

In signed grant agreements, as of 201/03/16,
- 76 BG SME grant holders, i.e., 19.74% 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)

**QERD as % of GDP**
- 0.49%
- 1.83%

Source: European Union Competitiveness Report 2011
Chapter 5 - Human Capital Formation

A. Overview of the Bulgarian Higher Education System

5.1 Tertiary education and research are among the key foundations of European integration. The EU supports the cultivation of skills and knowledge that promote labor mobility, particularly the high-order skills demanded by the rapidly developing global knowledge economy. Such knowledge-based workers are expected to have tertiary education.

5.2 In preparation for EU accession, Bulgaria has made significant changes to its higher education sector over the past two decades. The elitist system of the past has been transformed into a platform for broad-based higher education. The emergence and expansion of private higher education institutions (HEIs) has changed the sector’s size and structure and enhanced the competition among providers. Over the past two decades, five large private universities were created. Together with 13 smaller private HEIs and colleges and 33 public universities and HEIs, they form a system of 51 institutions of higher education.

5.3 With the sector’s expanding intake capacity, the number of higher education students increased by 16 percent over the last 10 years. Net tertiary enrollment of the age 19-23 population grew from 26 to 42 percent, and now stands at about 280,000, even as the number of secondary education graduates dropped by 13 percent during the same period, reflecting the rapid demographic transition occurring in Bulgaria. A major consequence of the mass participation in tertiary education is the increased heterogeneity of students, particularly with regard to their skills and learning capacity.

5.4 The quality of higher education has also increased, due in large part to the creation of the National Evaluation and Accreditation Agency (NEAA) in 1995, and subsequent institutional development support by the British Council and university and quality assurance practitioners from the UK. After periods of piloting evaluations and a series of legal amendments, in 2004 the NEAA also became responsible for post-accreditation and evaluation monitoring and oversight for all HEIs. Meanwhile, Bulgaria’s participation in the European Higher Education Area (Bologna process), launched in 1999, led to the introduction of the three-stage structure of higher education (bachelor, master, and doctor); the institutional reorganization and strengthening of the NEAA; and its membership in the European Association for Quality Assurance in Higher Education (ENQA) and the European Quality Assurance Register (EQAR).

5.5 Further strides were made in 1999 by revamping the funding model through the introduction of per capita financing of HEIs based on the number of enrollments. Then in 2000, universal tuition fees were introduced with little opposition, bringing significant changes to the income structure of the HEIs.

5.6 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. But despite its 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 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.

5.7 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.

5.8 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.

- Another major reform related to the funding model has been the gradual reorientation toward a stronger focus on HEIs 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.

- In the second half of 2011, legislative amendments laid 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.

5.9 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: Should HEIs be held responsible, and to what extent?

5.10 Assessing the quality of higher education is hampered by 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. 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. 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 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.

5.11 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 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 critical analytical capacity acquired in tertiary education to be converted to job skills.

5.12 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

76 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.
78 See www.competencemap.bg
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.

5.13 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 whole working population.

Figure 5.1: Average earnings with tertiary and secondary education across age groups (23-65y.o.) in 2006

Source: Cross section of log income based on data from the 2006 Labor Cost Survey of the NSI

5.14 The data indicate that people with higher education earn significantly more, and their earnings increase over time (see Box 5.1).

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 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 various 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 education of the parents, family background, quality of secondary education, the macroeconomic environment, and the changing labor market. 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
By contrast, people with secondary education seem to lose income at 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 physical force and dexterity than with 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. However, recent studies from the USA and other developed countries show that the lifecycle earning curves for people with tertiary education are changing in a way in which such end-of-career decline may no longer occur. Indeed, a simulation using three waves of the 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

5.15

a typical example. Such professions however 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)


5.16 One issue affecting the quality of tertiary education – and consequently the earning potential of high-skilled workers – is that it uses the inputs from secondary education, where performance does not look good in international perspective. A troubling fact is that young Bulgarians are lagging behind their counterparts abroad. Results from the OECD Program for International Student Assessment (PISA) surveys from 2000, 2006, and 2009, in which Bulgaria participated, show that in international comparisons, 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.

5.17 One issue that needs to be considered is that 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 exceptionally 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. This means that the Bulgarian University Ranking System (BURS), which has two editions (2010 and 2011) has captured the labor market performance of the 2000 cohort, having relatively strong cognitive skills, while the assessment of teaching was done on the basis of the 2006 cohort. Based on the existing data it is too early to assess cohort effects on HEI

performance, but one important lesson to remember 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.

Figure 5.3: Scores of Bulgarian 15-year old students in reading, mathematics and science in the PISA survey of OECD

![Graph showing scores of Bulgarian 15-year old students in reading, mathematics and science in the PISA survey of OECD](image)

Source: OECD

5.18 Moreover, the 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.

5.19 As shown in the analysis below, some universities have a positive effect on graduate earnings, and others have a negative effect on earnings—even without taking account of the cost of education and the opportunity costs involved. The choice of area of study is of particular importance for both income and unemployment risks.

5.20 The following graph 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.

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5.21 The next two graphs show earnings for bachelor’s degrees, disaggregated by universities. The small triangles represent the averages for the different areas of study taught at the corresponding universities.

**Figure 5.4: Impact of Higher Education on Taxable Income and Unemployment Risks, 2007-2010 (BGN/month)**

![Graph showing impact of higher education on taxable income and unemployment risks.](image)

*Source: MEYS, AdminUni database*

**Figure 5.5: Average Monthly Earnings for Graduates with Bachelor’s Degrees (BGN)**

![Graph showing average monthly earnings for graduates with bachelor’s degrees.](image)
5.22 As the graphs show, 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.

5.23 The link between tertiary education and labor market performance is complex, and customer 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. Nevertheless, the evidence shows that institutions of tertiary education can contribute to better labor market outcomes by:

1) 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 don’t require tertiary education.

2) 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.

3) 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 key to success. Currently internships are 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.

Box 5.2: Innovative entrepreneurs in the rural area - Norway

Starting your own business in a rural area? In Norway, we saw 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 industrialisation, and to market Norway as a tourist destination. The institute aims to release the commercial opportunities of the region by encouraging innovation, internationalisation 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, input of knowledge, helping building network 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 god practices for lifelong learning, July 2008

C. Regional aspects of human capital formation in Bulgaria – territorial and interoccupational mobility

5.24 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 can be 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.

**Figure 5.6: Geographic distribution of new university graduates**

![Map of geographic distribution of new university graduates in Bulgaria](image)

*Source: Ranking system of Bulgarian Universities*

5.25 Bulgaria’s uneven distribution of human capital can be seen both from 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.

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).
Figure 5.7: 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

5.26 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 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.

5.27 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, and this cannot satisfactorily describe 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.

85 Market potential figures were taken from Stoychev, K. (2012), Локализационни подходи за регионално развитие (Localization approaches in regional development), University Publishing House "St. Kliment Ohridski".
Figure 5.8: Impact of Market Potential and Share of Tertiary Graduates

Source: BURS for tertiary graduate data and Stoychev (2012) for market potential estimates

5.28 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.

5.29 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 not high either; it is certainly much lower than the number of university graduates seeking jobs. Then the question is: which activities could generate real demand for more people with higher education?
The university of Lusofona, Portugal lead EU project to create environment for creative and commercial success in cinema. Lusofona is 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.

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 industry, and that the industry can tap into this talent and keep itself up-to-date with new skills and technologies. However, barriers to improved cooperation must be overcome.

For its part, industry is 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 sharing 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, helping enable teaching staff in Portugal, Africa, and Brazil to virtually collaborate regularly 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.

The head of the film school at the university had a vision 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 an 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.

5.30 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. 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.

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D. Outflow of human capital from the country and the economic potential of the Bulgarian diaspora

5.31 It is generally assumed that Bulgaria has suffered a significant outflow of qualified people over the last two decades. However, the data indicate that the process of emigration is not specifically a brain drain. In reality, it is a “population drain”, as people with all qualifications are emigrating, and brain drain is only 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.

Figure 5.9: Flows of emigrants from Bulgaria during the period starting in 1989


5.32. 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. 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 and reducing the available workforce.

88 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.
5.33. Information from the OECD database of emigrants shows that the process of emigration affects groups with all qualifications.\textsuperscript{89} 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.

5.34. 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 country 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 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.

5.35. Indeed, data on the occupations of Bulgarian immigrants to OECD countries show that only a quarter of them are managers or professionals.

\textsuperscript{89} 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).
5.36. 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 actually almost exactly mirrors the educational composition of the population. As discussed in chapter 4, the scientific labor market has been affected by this trend, particularly as a result of the wage gap between researcher positions in Bulgaria and those in the rest of Europe.

5.37. The 2011 census shows that 233,000 people have returned from abroad relative to the last census and that this group’s education is skewed towards the higher levels. People with higher education are especially overrepresented (see Figure 5.12).

5.38. 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.90

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There are also some 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 receiving orders from companies based in foreign countries. But such examples are still the exception. Repatriation grants given by the National Science Fund have had controversial results. They have led 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

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, Energy and Tourism, 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, Youth and Science, as the line ministry responsible for policies on secondary vocational and higher education; and
e) Universities and other institutes for higher education, both public and private, concerning the possible lessons for their curricula, marketing, and overall organization strategies.

5.41. The Bulgarian workforce is in a process of adapting to a changing economic situation. Some of the changes make the environment more challenging and demanding in terms of competencies required to find and keep a job. Many workers with lower skills and lower productivity are losing their jobs. This difficult adaptation will continue even without any policy support, but it can be greatly facilitated by appropriate interventions, including, as a priority, measures to address labor market mismatches.

i. It is necessary to define some priorities in the economy so that the workforce development policy can have a better focus. This will help also the business to plan their investments. Education will remain a risk investment requiring government support both for the demand and supply side.

ii. Positive changes in the economy can be triggered by proactive and forward looking policies for human capital formation. The availability of a higher skilled labor force is likely to attract or foster more entrepreneurs who invest in innovation. The current examples are based on previous investments in human capital and the availability of the relevant educational infrastructure and teachers.

iii. A system for skills forecasts needs to be established, which should be based on forecasts concerning the development of the economy. Currently there are several projects of this type funded by the EU funds – one such project is implemented by the Bulgarian Industrial Association.

iv. Coordination between the EU operational programs needs improvement, for example coordination between the Human Resource Development Program and the Competitiveness Program in designing and implementing workforce development measures.

v. The experience from the existing grants for repatriation of researchers from the Bulgarian diaspora is controversial. This may be due to the very limited number of cases, but the design and conditionality of the grants and the parallel support need to be examined as well. A special focus on attracting young people studying abroad should be added to the current efforts to attract established researchers.

vi. There is a need for more training opportunities which are well focused in terms of content and shorter than the usual duration of formal courses in the post-secondary and tertiary education. SISCO academy provides an example of how such training can be organized, although it does not function at the moment.

vii. There is a recognized need for vocational education reform. It is reflected to some extent in the new draft law on school and pre-school education but 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.
viii. The system of vocational guidance needs to be supported. It is necessary to improve the capacity of the organizations providing vocational guidance services and the training of specialists. Reliable information on existing and prospective career opportunities should become easily available to graduates from the secondary and tertiary education.

ix. The transition from education to employment has to be made smoother. The “Quick Start” program implemented by the employment agency has provided a positive example. The program followed the model of the Quick Start in the US.

x. Incentives for studying in technical and engineering specialties are needed. Currently too many university students still choose areas of study like economics and law though there are clear signs of oversupply.

xi. Creation of new clusters can 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. A special program for the modernization of vocational schools could be considered through which the Ministry of Education in cooperation with the Investment Promotion Agency could support vocational schools in places where large private investments in relevant sectors have been made or are considered.

xii. Currently student practice programs are implemented formally. The European Commission is putting a focus on improving the training experience of university students in real business environment. As an additional incentive, training could be recognized as work experience for social insurance purposes.

xiii. The system of formal education should be made more open to the training of adults. Training programs need improvement; they need to be adapted to the needs of adults both in terms of content and flexible timing.

xiv. 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. But it can be hardly successful if generic skills are missing.

xv. The introduction of a system for validation of informally acquired qualifications would be very helpful. The system can also be used to validate high skills, including e.g. programming skills.

xvi. New approaches in employment promotion should be considered. Employment programs can be reshaped in a way that will both support innovation policies and cause the short-term reduction of unemployment

xvii. The quality of research in universities needs to be supported if they are to play any significant role in innovation. This will likely require some reduction in the time for teaching in order to leave more time for research activities.

xviii. Both universities and vocational schools need to be incentivized to respond to the right signals coming from the labor market.
5.42. In general the Bulgarian education system has still to reap the full benefits from EU membership. Bulgarians got since 2007 growing opportunities to access the labour markets of developed EU countries, to live there and study in their universities. Teachers and researchers in Bulgarian HEIs are getting new opportunities to cooperate with their EU counterparts and globally by joining forces for more advanced and expensive research, designing shared academic programs. Not least large EU funds for research, infrastructure and human capital investment have become available and their adequate absorption remains a challenge. Most of these opportunities, however, have still to be adequately utilized.

5.43. The period until 2020 will be very important for the development of the Bulgaria economy and education is to play a key role. Important changes will have to be introduced in both the secondary and tertiary education, which have already started with the adoption of new legislation and increased pressure to improve both accessibility and performance. In parallel Bulgaria will have to create a life-long learning system with diversified opportunities for learning and skill acquisition to meet the demands of a knowledge-driven economy.
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. 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.

91 Åke Andersson (2009), 'Returns to Higher Education', The Royal Institute of Technology, CESIS Paper 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 the 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 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 from similar interventions in the country/sector to provide the empirical support for a suggested M&E of a development intervention.

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:
  
  o **Clear** - precise and unambiguous
  o **Relevant** – appropriate to the subject at hand
  o **Economic** – achievable at a reasonable cost
  o **Adequate** – sufficient to assess performance
  o **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.
Figure 6.1: New Logical Framework for Monitoring and Evaluation

6.8. Outcome indicators and targets must be determined at program level – in the Operational Programs and in the Partnership Contracts – 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, 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.
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.

6.19. 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.

Evaluating Monitoring and Evaluation System of NRP and OP-IE in Bulgaria

6.20. The implementing body for the operational programs, MEET, provides a rich set of context, output, and result (outcome) indicators in its operational guidelines. A review of these indicators in both the OP-IE and the NRP called attention to the following issues in order to improve the feedback obtained from M&E activities that are conducted in Bulgaria:

a. Expanding the indicators would contribute to better measurement of progress. The Operational Program document provides many output indicators, but too few results indicators. Priority Axis (PA) I has only one results indicator, and PA2 and PA3 have none. 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.

92 A fifth thematic priority, “Removing bottlenecks in key network infrastructures,” is usually included under this objective.
b. **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 public research organizations 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.

c. **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.

d. **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.

e. **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 tables 6.1-6.3.

f. **In addition to regular monitoring visits during the project life, MEET 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.

g. **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.

h. **Better coordination between MEET 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 MEET, 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 MEET 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.

Possible Additional Indicators for Innovation Policy Priorities in the NRP

6.21. One of the national targets presented in Bulgaria’s National Reform Program is for R&D investment to be at 1.5 percent of GDP by 2020. The success of measures aimed at promoting innovation will contribute to achieving this target. A well-structured M&E framework implemented in every Operational Program will help 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.

6.22. 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.

6.23. 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

6.24. 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>
</tr>
<tr>
<td></td>
<td>Adoption and implementation of National Strategy for the Development of Scientific Research 2020</td>
</tr>
<tr>
<td></td>
<td>Preparation of national strategy for creative industries</td>
</tr>
<tr>
<td></td>
<td>Monitoring the agencies responsible from implementation of RIS3</td>
</tr>
</tbody>
</table>
Research Institutions and Human Capital Development

6.25. 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>
</tr>
</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>
</tr>
<tr>
<td></td>
<td>Number of joint publications by researchers from PRO and businesses per million inhabitants</td>
</tr>
<tr>
<td></td>
<td>Number of spin-off companies from PROs</td>
</tr>
<tr>
<td></td>
<td>Share of PRO income from patents and licensing revenues as a share of total PRO income</td>
</tr>
<tr>
<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>
</tr>
<tr>
<td>2 Increase Cooperation with R&amp;D institutes in Europe and globally</td>
<td>Number of foreign research institutions collaborated with</td>
</tr>
<tr>
<td></td>
<td>Amount of foreign funds attracted through internationally collaborated projects</td>
</tr>
<tr>
<td></td>
<td>Number of scientific publications co-authored with foreign researchers per million inhabitants</td>
</tr>
<tr>
<td></td>
<td>Number of research teams implementing projects on Single Network of European high-performance centers (DEISA)</td>
</tr>
<tr>
<td></td>
<td>Share of projects financed through National Science Fund that has a foreign partner</td>
</tr>
<tr>
<td></td>
<td>Number of researchers participating in Partnership for Advanced Computing in Europe (PRACE) projects</td>
</tr>
<tr>
<td></td>
<td>Number of projects supported by European Cooperation in Science and Technology (COST)</td>
</tr>
<tr>
<td>3 Increase quality of research and quantity of researchers in public research organizations</td>
<td>Number of research projects financed by National Science Fund</td>
</tr>
<tr>
<td></td>
<td>Number of projects attracted funds from European Horizon 2020 program</td>
</tr>
</tbody>
</table>
Amount of funds received by Horizon 2020 or other international programs

Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country

Scientific publications per million inhabitants

Scientific publications per thousands of R&D employment in the public sector

*Scientific publications per thousand inhabitants in a particular region with respect to country average*

PCT patents applications per million inhabitants

PCT patents applications per million inhabitants in priority sectors (e.g. ICT, pharmaceutical)

Percentage of PhD degrees in science and engineering per million inhabitants

*Percentage of new PhD/Master graduates in priority sectors*

Percentage of new PhD/Master graduates employed in regional businesses and regional research institutes

*Share of scientific and technological personnel trained in priority technology fields*

Share of high and middle-tech exports in total exports

Licensing revenues gained by PROs on new innovations

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### Developing Business Innovation Ecosystem

6.26. 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 Increase scientific and innovative products produced in centers of excellence (TTOs, science parks, incubators, clusters etc.)</td>
<td>Number of projects completed under National Roadmap for Scientific Infrastructure Number of research and entrepreneurship centers in universities Number of students trained in these centers</td>
</tr>
<tr>
<td>2</td>
<td>Increase international engagements and foreign collaboration</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Number of projects supported by these centers</td>
</tr>
<tr>
<td></td>
<td>Number of projects funded in these centers</td>
</tr>
<tr>
<td></td>
<td>Total value of projects funded in these centers</td>
</tr>
<tr>
<td></td>
<td>Number of product/process innovations introduced in these centers</td>
</tr>
<tr>
<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 is used in these centers</td>
</tr>
<tr>
<td></td>
<td>Occupancy rates in these centers</td>
</tr>
<tr>
<td></td>
<td>Number of projects funded in priority sectors (in ICT, pharmaceutical etc.) in these centers</td>
</tr>
<tr>
<td></td>
<td>Number of firms involved in a business cluster</td>
</tr>
<tr>
<td></td>
<td>Share of firms collaborate with each other in the cluster</td>
</tr>
<tr>
<td></td>
<td>Number of firms involved in a business cluster in a priority sector</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3</th>
<th>Promotion of R&amp;D activities, commercialization of innovation, and smart specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of SMEs getting assistance from Enterprise Europe Network</td>
</tr>
<tr>
<td></td>
<td>Number of projects awarded as EUREKA project</td>
</tr>
<tr>
<td></td>
<td>Number of projects funded by EUROSTARS program (alternatively, Amount of funds generated through EUROSTARS program or success rate on the projects funded by EUORSTARS program in comparison to those that are not)</td>
</tr>
<tr>
<td></td>
<td>Share of new high-tech companies among all new businesses</td>
</tr>
<tr>
<td></td>
<td>Share of new establishments in knowledge intensive sectors</td>
</tr>
<tr>
<td></td>
<td>Employment in knowledge-intensive activities (manufacturing and services) as % of total employment</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Share of value added of activities with high share of knowledge in total value added</td>
</tr>
<tr>
<td></td>
<td>Share of firms conducting R&amp;D that have not performed R&amp;D in the past three (or five) years</td>
</tr>
<tr>
<td></td>
<td>Change in the productivity (value added per worker) of firms that benefited from the programs</td>
</tr>
<tr>
<td></td>
<td>Volume of capital raised by firms in the programs</td>
</tr>
<tr>
<td></td>
<td>Share of firms introducing new products, processes, designs</td>
</tr>
<tr>
<td></td>
<td>Share of firms introducing new products, processes, designs in priority sectors</td>
</tr>
<tr>
<td></td>
<td>Share of firms introducing new products, processes, designs in a particular region with respect to all country</td>
</tr>
<tr>
<td></td>
<td>Share of SMEs cooperating with other companies and PROs in innovation among all SMEs</td>
</tr>
<tr>
<td></td>
<td>Number of days required for registering a new business</td>
</tr>
<tr>
<td></td>
<td>Entry rate of firms in priority sectors</td>
</tr>
<tr>
<td></td>
<td>Growth of employment in knowledge intensive sectors</td>
</tr>
<tr>
<td></td>
<td>R&amp;D expenditure per worker</td>
</tr>
<tr>
<td></td>
<td>R&amp;D expenditure per worker in priority sectors (pharmaceutical sector)</td>
</tr>
<tr>
<td></td>
<td>Share of first-time exporters (systematically) or first-time foreign investors due to the project.</td>
</tr>
</tbody>
</table>

6.27. 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**

6.28. 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.*
6.29. An M&E framework was implemented throughout the project. The indicators chosen, the targets set, and how the results were interpreted for the project are presented here to shed some light on how an M&E framework should be designed.

6.30. 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.

6.31. The output indicators used to monitor the programs are presented in Table 6.4.

<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 abroad</td>
<td>None</td>
<td>18</td>
<td>37</td>
<td>30</td>
</tr>
<tr>
<td>Projects involving cooperation with the industry</td>
<td>None</td>
<td>8</td>
<td>28</td>
<td>15</td>
</tr>
<tr>
<td>Projects with young scientists</td>
<td>None</td>
<td>18</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>Projects successfully completed (as evaluated by UKF evaluation committee)</td>
<td>None</td>
<td>2</td>
<td>59</td>
<td>30</td>
</tr>
</tbody>
</table>

6.32. 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.

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

6.33. There are two types of evaluations of an organization’s program: causal and non-causal. Impact evaluation goes beyond monitoring and evaluation 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.

6.34. 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 correctly show that the grants program increased investment.

Figure 6.3: Monitoring Alone Can Produce Misleading Results
6.35. 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.
- **Influential**. The results will be used to inform key policy decisions.  

6.36. 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**

6.37. **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](image)

6.38. 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

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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.

6.39. 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 30 percent more by mid-term review. This suggests that the implementation process was itself aided by the impact evaluation.

6.40. Finally, impact evaluation is a public good that can contribute to global knowledge about the likely effects of similar programs.

E. Testing Program Variations

6.41. *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.

6.42. 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.

6.43. 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*

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
6.44. 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

6.45. 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.

6.46. As these examples show, in many cases a program can be slightly 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.
F. Impact Evaluation in the EU

6.47. 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

6.48. 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. 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.

6.49. 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

6.50. 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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94Descriptions 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.

6.51. 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 sub-group: 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**

6.52. 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.
The Czech Republic instituted an Enterprise and Innovations Operational Programme which provided several types of subsidies to encourage R&D (DHV CR, 2011). Some subsidies were for general R&D and patenting; some were designed to encourage collaboration; some were designed for younger and smaller firms.

An external consulting firm, DHV CR, conducted an impact evaluation of the program, using matching methods to introduce a counterfactual.

Depending on the program variation examined, DHV found a small increase in product diversification; an increase in the quality of products; no effect or a decrease in employment; a rise in production capacity; and many other results which helped to inform the subsequent round of the program.

**G. Impact Evaluation of Smart Specialization Instruments**

6.53. 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.

**Matching Grants / Incubator Programs**

6.54. Matching grants and incubator 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?
Technology Park / Subsidized Access to Infrastructure or Services

6.55. A technological park exists or it does not; infrastructure and services are usually most cost-effective if provided to a large number of firms or no firms. This type of intervention is therefore a blanket program, which can be evaluated by using an encouragement design, whereby some firms may be encouraged to sign up. Encouragement designs can capture both the effect of offering the encouragement and the effect of the treatment on the treated. Some potential program variants are discussed below.

- *Broad targeting versus narrow targeting or no targeting.* What kind of targeting produces the best results – extending the encouragement to certain sectors, certain sub-sectors, or to everyone regardless of sector?
- *Different requirements to obtain access.* What will the firm be required to show in order to gain access? For example, does the program target a certain size or age of firm?
- *Different benefit levels.* What kind of subsidy level should be set? What kinds of benefits should be extended by the technology park?
- *Different timing of the benefits.* At what point should the firms receive the benefits? Should firms be offered a particularly attractive incentive to join the tech park?
- *Different types of and combinations of benefits.* Are some benefits more useful than others? Is there some additionality to providing more than one kind of benefit at the same time?

Policy Changes

6.56. Policies are also generally blanket interventions. Testing policy variations has special difficulties, but some suggestions are listed below.

- *Broad targeting versus narrow targeting or no targeting.* What kind of targeting produces the best results? Extending the encouragement to certain sectors, certain sub-sectors, or to everyone regardless of sector?
- *Different policy variants can be tested in different settings.* For example, municipal-level policies could vary across municipalities.
- *Different ways of promoting take-up of the policy’s benefits.* What is the best way to advertise the policy change? An encouragement design, as discussed above, could evaluate both the effect of the encouragement and the effect of the policy change on those who react to the encouragement.

6.57. 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,” which can be determined by test different program variations. With the knowledge gained, future iterations of each program can be made much more effective at encouraging innovation.
Recommendations

6.58. _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 outcome (results) indicators are presented. For Priority Axis (PA) I, there is only one outcome indicator, and for PA 2 and 3 there are no outcome indicators. Output and outcome indicators should be balanced and closely linked with the results of specific interventions.

6.59. _Include indicators that address additionality._ Some outcome indicators should be designed to capture the extent to which a program has created – or may be crowding out – additional private R&D investment. For example, in research projects involving collaboration 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 or institutions, the indicator could measure how much R&D investment is contributed by the foreign partners. For publicly supported research projects, the indicator could measure how many of those projects are later accepted in the Horizon 2020 program.

6.60. _Indicators and their targets must be set at both the program and procedure levels._ Operational program indicators provide information useful for program monitoring. Most indicators are set at the priority axis (PA) level; however, some of these indicators actually cover not the program itself, but procedures designed to support innovation projects as they move from prototyping to commercialization. These procedure indicators need to be defined more narrowly, as either a product, process, or design indicator, to help identify bottlenecks at every stage in the commercialization process. Periodic evaluation reports should assess the additionally generated at each priority axis and procedure level.

6.61. _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 link to networks in European markets through EUREKA, EUROSTARS, Enterprise Europe Network, or similar programs, could be a single indicator in the action plan.

6.62. _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.

6.63. _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 could constitute the program evaluation committee.

6.64. _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.
E. Conclusion

6.65. 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.

6.66. Monitoring and Evaluation and Impact Evaluation tools must 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.
ANNEX

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

6.67. **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**

6.68. 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.

6.69. 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](image)

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
6.70. 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.

![Graphical representation of timing of roll-out](image)

6.71. 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**

6.72. 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.

6.73. 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.
6.74. 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.

6.75. 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**

6.76. 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.

6.77. 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.

6.78. 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**

6.79. 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.

6.80. 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

6.81. 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.

6.82. 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.

6.83. 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.

6.84. 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.

6.85. 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. 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 targeted government support. 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. This chapter provides a snapshot review of sectors with the potential to have a significant impact on the overall competitiveness of the Bulgarian economy and can benefit from innovation-driven growth. It assesses constraints to development in the four priority sectors identified jointly with MEET – food processing, machine building and electronics (MBE), pharmaceuticals, and ICT. 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 four 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.

7.3. 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.

7.4. This snapshot review uncovered constraints to innovation-driven growth that are sector specific, but also constraints that are common for all sectors.
Table 7.1: 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>
</table>
| Food processing      | - Lack of technological and equipment upgrading  
                      - Insufficient supply chain                                                                 | - Shortage of skilled labor  
                      - Lack of collaboration between the business, university and research communities  
                      - 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 |
| Mechatronics         | - Large number of small players at lower end of the value chain                                          |                                                                                                           |
| Pharmaceuticals      | - Lack of transparent regulation and procedures for early stage clinical trials                         |                                                                                                           |
| ICT                  | - Inadequate system for protection for ICT related assets such as service innovation and business process innovation |                                                                                                           |

7.5. The following section provides more details about each of these sectors.

**B. Sector Analysis**

**I. 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**

7.6. 2011 EU sector development snapshot

- 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);

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95Author’s calculations.
- 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 = EUR60,000);
- 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.

Table 7.2: Bulgaria Food Sector Snapshot

<table>
<thead>
<tr>
<th>SEGMENT</th>
<th>INCOME (000, BGN)</th>
<th>EMPLOYEES</th>
<th>COMPANIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food production</td>
<td>2 948 029</td>
<td>84 343</td>
<td>5 456</td>
</tr>
<tr>
<td>Fruit and vegetable processing</td>
<td>558 006</td>
<td>16 229</td>
<td>528</td>
</tr>
<tr>
<td>Sugar and confectionary</td>
<td>343 223</td>
<td>7 960</td>
<td>116</td>
</tr>
<tr>
<td>Dairy (cheese)</td>
<td>312 748</td>
<td>7 951</td>
<td>383</td>
</tr>
<tr>
<td>Bread and bakery</td>
<td>299 334</td>
<td>28 434</td>
<td>3 307</td>
</tr>
<tr>
<td>Beverages</td>
<td>852 002</td>
<td>24 667</td>
<td>1 688</td>
</tr>
</tbody>
</table>

Source: Author’s calculations.

7.7. 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.
7.8. 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.

7.9. 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.

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 share of the domestic market and enter new markets abroad and through technology-induced productivity gains, improvements in energy efficiency and better skilled labor force.

7.10. 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

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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 becoming more organized.

**Key challenges in the food processing sector**

7.11. 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.

7.12. 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.

**Regional development and specialization**

7.13. 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.

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97Funding targeted for all research, through the National Science Fund, is approximately BGN 7 million per year an insignificant portion to food research.
Table 7.3: 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>


7.14. 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.

7.15. 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.

7.16. 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.

7.17. 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.

7.18. 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

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98 Large investors such as Coca Cola and PepsiCo are increasing production of fruit flavored carbonated soft drinks.

99 There are eight Bulgarian juice producers, which have 93 percent of the market share.
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.

7.19. 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

7.20. This segment is developing rapidly, particularly for low to moderately priced wines. Eighty percent of wine production is exported.\(^{100}\)

Organic foods

7.21. 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.

7.22. The production of certified organic foods is increasing; organic products include cereals, soy beans, oatmeal, fruits (plums, cherries, peaches, raspberries, strawberries), walnuts and other nuts, medicinal and aromatic plants, and honey.

7.23. Another trend is the development of certified organic livestock (sheep, goats, pigs, cattle), and the import of certified organic livestock for breeding.

Sector ecosystem

7.24. 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

7.25. 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

\(^{100}\) 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.
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 7.2.
Box 7.2: Linking Research and Market Needs – Proviti JSC

History and Development

Proviti (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 heralds 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 innovation cycle and technological transfer processes. It is a dynamic company, which based on its clear vision successfully links science and business to develop innovative products and processes with high added value. The company’s vision is based in understanding innovation and in-depth knowledge bringing successfully innovative products from scientific discovery to the market place.

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 (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.

7.26. 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.\(^\text{101}\)

7.27. Other areas of innovation include new packaging technologies (edible coatings, controlled or modified atmosphere packaging, intelligent packaging, clean room technologies); inspection systems using new sensing methods; and tracking and tracing systems to ensure product safety and guarantee product origin.

7.33 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 7.3).

\(^{101}\) 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.
Box 7.3: 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 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**

7.34. 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:
• 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.

7.35. The food processing sector is becoming more competitive despite a high proportion of outdated production equipment. However, structural problems in the food stuffs 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.

7.36. 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.

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>
</tr>
</thead>
<tbody>
<tr>
<td>1 MesniProdukti “Zhar” (Varna)</td>
<td>7,739.34</td>
<td>4,782</td>
<td>61</td>
<td>47</td>
<td>101</td>
</tr>
<tr>
<td>2 Nordiks (Trud)</td>
<td>1,866.93</td>
<td>12,667</td>
<td>644</td>
<td>128</td>
<td>16</td>
</tr>
<tr>
<td>3 Mandra “Rilsiti” (Sofia)</td>
<td>272.64</td>
<td>16,016</td>
<td>4,298</td>
<td>572</td>
<td>132</td>
</tr>
<tr>
<td>4 Boomerang 2009 (Sofia)</td>
<td>269.70</td>
<td>4,466</td>
<td>1,208</td>
<td>683</td>
<td>30</td>
</tr>
<tr>
<td>5 Trakia 2006 (Plovdiv)</td>
<td>259.18</td>
<td>34,438</td>
<td>9,588</td>
<td>1,693</td>
<td>208</td>
</tr>
<tr>
<td>6 Bulmes Group (Sofia)</td>
<td>256.62</td>
<td>5,310</td>
<td>1,489</td>
<td>131</td>
<td>57</td>
</tr>
<tr>
<td>7 Kris-Oil-97 (Kaspichan)</td>
<td>172.20</td>
<td>6,236</td>
<td>2,291</td>
<td>132</td>
<td>40</td>
</tr>
<tr>
<td>8 Bulmalts (Sofia)</td>
<td>142.45</td>
<td>13,257</td>
<td>5,468</td>
<td>272</td>
<td>49</td>
</tr>
<tr>
<td>9 Merkez (GotseDelchev)</td>
<td>135.52</td>
<td>29,141</td>
<td>12,373</td>
<td>2,491</td>
<td>76</td>
</tr>
<tr>
<td>10 Fishcom (Sliven)</td>
<td>129.45</td>
<td>4,534</td>
<td>1,976</td>
<td>1,041</td>
<td>165</td>
</tr>
<tr>
<td>11 Eco Furazh (Varna)</td>
<td>120.11</td>
<td>5,003</td>
<td>2,273</td>
<td>1,618</td>
<td>61</td>
</tr>
<tr>
<td>12 Pleven-Mes (Pleven)</td>
<td>118.01</td>
<td>4,201</td>
<td>1,927</td>
<td>202</td>
<td>40</td>
</tr>
<tr>
<td>13 Exotic 2000 (Star Zagora)</td>
<td>117.55</td>
<td>11,815</td>
<td>5,431</td>
<td>3,070</td>
<td>54</td>
</tr>
<tr>
<td>14 SiCo (Pleven)</td>
<td>103.19</td>
<td>4,017</td>
<td>1,977</td>
<td>58</td>
<td>39</td>
</tr>
<tr>
<td>15 Agroplant (Gramada)</td>
<td>94.71</td>
<td>2,798</td>
<td>1,437</td>
<td>313</td>
<td>12</td>
</tr>
<tr>
<td>16 MoniMes (Haskovo)</td>
<td>93.18</td>
<td>5,691</td>
<td>2,946</td>
<td>36</td>
<td>38</td>
</tr>
</tbody>
</table>
7.37. The sector’s strengths, weaknesses, opportunities, and threats are summarized in Table 7.5.

Table 7.5: 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.</td>
<td>- Low level of R&amp;D and innovation intensity</td>
</tr>
<tr>
<td>- High standards for food quality and safety and</td>
<td>- Weak collaboration between businesses in the sector, universities and research institutions</td>
</tr>
<tr>
<td>- Well-developed transportation and distribution network</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>- Low labor costs</td>
<td>- 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</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 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>
</table>

### II. 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
7.38. **2011 EU sector development snapshot**:

- Electronics and electrical equipment sector in EU employs around 3.6 million people and had an output of EUR50.8 billion 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 labor costs and qualified labor 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 groundbreaking 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:*

7.39. 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 7.6 below. Data for subsectors respective numbers is also presented in the table.

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Table 7.6: Machine building sector revenue indexes (year 2008 = 100 percent)

<table>
<thead>
<tr>
<th>Sub-sectors</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>
<tr>
<td>C 29</td>
<td>52.52</td>
<td>74.05</td>
<td>84.17</td>
</tr>
<tr>
<td>C 30</td>
<td>98.06</td>
<td>95.57</td>
<td>116.8</td>
</tr>
</tbody>
</table>

Source of data: Machine building sectoral trends analysis, Machine Building Bulgarian Chamber, October 2011.

Note: C28 – Specialized and common purposes machine buildings; C25 – Metal works (machine building excluded); C29 – Automobiles and trailers production; C30 – Other vehicles production (automobiles excluded).

7.40. 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 7.7 below.

Table 7.7: 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>


7.41. Despite the economic downturn, the quality, combined with the competitive pricing of sector products, resulted 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

7.42. Low value-added repair work is growing and high value-added building of transport machinery, including ships and railway equipment, is declining. 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 transport equipment subsector. The biggest shipbuilding company – “Bulyard Shipbuilding Industry” has been privatized five years ago and is currently offering ships construction, repairing and conversions services, reaching revenues for 2010 of around EUR40 million. 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, where the result of it are still difficult to assess and there is no public information available about the financial performance of the company. However the company has positioned on the EU market and is currently working as a subcontractor for some leading companies in EU as AhausAlstaetterEisenbahn - AAE” AG – Switzerland.

Automotive& electronics

7.43. 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. However the country has, attracted some EU investments from large sector players. There is, however, a nascent automobile manufacturing cluster in Bulgaria, which has attracted the interest of multinational companies, mainly in the auto assembly and auto parts production area. 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. There are also a number of local companies that are producing successfully electric vehicles components and engines for the EU market.

7.44. The sector has been developed on the basis of an ecosystem of multinational and local firms. There are currently a number of large international companies like Siemens, Schneider Electric, Hyundai Heavy Industries, Liebherr, ABB, that have chosen Bulgaria as their destination for doing business in Eastern Europe. The biggest in revenue sub-segments of the Electronics sectors 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.

7.45. Recently there is even a stronger sector development where the largest private automotive company in China (Great Wall), recently invested in a car assembly factory near Lovetch, which prove 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

103 The strong competition from China creates some challenges for this company and subsector and the company has generated EUR15 million losses for 2010.
and LED lighting, and the Bulgarian Bulmineral signed at the end of 2012 a joint-venture 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.

7.46. That is yet another positive signal for the development of the Bulgarian car manufacturing sector after the announcement two weeks ago from the Ukrainian company “Lviv Bus Plant” (LAZ) that will start assembling buses and trolleybuses in the city of Gabrovo, in Central Bulgaria. 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.

7.47. 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 7.8: 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 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 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 Eika-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 Budeshnosti (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 Mictronik (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>


Key challenges in the machine building and electronics sector

7.48. 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.

7.49. 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.

7.50. 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

7.51. 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 – molds and hoist production;
- Stara Zagora – food processing machinery and metal processing;
- Kazanluk – hydraulics;
- Varna, Rousse, Bourgas – 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.

From 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.
7.52. According to the EU cluster observatory, Western-Central and North-Eastern regions are ranked among the top 20 regions for manufacturing of machines. Table 7.9 shows some specialization in different regions, with the strongest specialization being in North East region, focused on ships and boat building and repairing:

Table 7.9: 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>7 239</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>


7.53. The largest sub-segments in terms of revenue generation are the electronics components and electric domestic appliances. Sub-segments are represented in more details in Table 7.10 below.

Table 7.10: 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>
<tr>
<td>Other electronic and electric wires and cables</td>
<td>188 903</td>
<td>4 368</td>
<td>54</td>
</tr>
<tr>
<td>Electric domestic appliances</td>
<td>225 332</td>
<td>2 940</td>
<td>18</td>
</tr>
<tr>
<td>Electronic components</td>
<td>280 600</td>
<td>5 655</td>
<td>151</td>
</tr>
</tbody>
</table>


Sector innovation ecosystem

7.54. 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

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105 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
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.

7.55. 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.

7.56. 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 7.4: Bulgarian innovation in electromobiles- IKEM Corp.

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**Box 7.4: 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 and etc.

The successful prototype development proved that the implemented method is productive and will be multiplied 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 gives a great opportunity for 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.

7.57. 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.

7.58. 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**

7.59. 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.

7.60. 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 groundbreaking 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.106

7.61. 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

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106CleanTech is an emerging cluster industry, which incorporates a number of sub-industries (manufacturing of mechanical components, electronics, chemistry and biotech).
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 7.11: 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,</td>
<td></td>
</tr>
<tr>
<td>the Middle East and the CIS</td>
<td></td>
</tr>
<tr>
<td>- Presence of successful international companies providing technology</td>
<td></td>
</tr>
<tr>
<td>transfer and dissemination that can spur the next level of innovation-</td>
<td></td>
</tr>
<tr>
<td>driven growth</td>
<td></td>
</tr>
<tr>
<td>- Successful pilot clusters developing products in the highest value-</td>
<td></td>
</tr>
<tr>
<td>added market segments, such as automotive components and electronics,</td>
<td></td>
</tr>
<tr>
<td>electro mobiles, LED lighting, advanced hydraulics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Ageing workforce</td>
</tr>
<tr>
<td></td>
<td>- Declining number of students in engineering and devolving quality of</td>
</tr>
<tr>
<td></td>
<td>engineering higher education.</td>
</tr>
<tr>
<td></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</td>
<td></td>
</tr>
<tr>
<td>engineering and electronics, LED lighting, hydraulics) where with</td>
<td></td>
</tr>
<tr>
<td>targeted support there is the potential to develop specialization</td>
<td></td>
</tr>
<tr>
<td>as a niche player and “plug” into the global value chain, through</td>
<td></td>
</tr>
<tr>
<td>partnering with leading companies.</td>
<td></td>
</tr>
<tr>
<td>- Leverage cooperation with key EU R&amp;D centers in the EU and abroad,</td>
<td></td>
</tr>
<tr>
<td>to further develop local R&amp;D capacity and increase the technology</td>
<td></td>
</tr>
<tr>
<td>absorption.</td>
<td></td>
</tr>
<tr>
<td></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>
</tbody>
</table>

III. Pharmaceutical sector

7.62. 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.

7.63. 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.

7.64. 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 (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), more than 20 percent of whom 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.\(^\text{108}\)

**Figure 7.1: Pharmaceuticals and Biotechnology Top the List of R&D Investment (2009, b. EUR)**


7.65. 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

\(^{108}\) For more information, see European Federation of Pharmaceutical Industries and Associations at www.efpia.eu.
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.

7.66. 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 (Figure 7.2).

Figure 7.2: FDI in percent of GDP

Source: UNCTAD FDI webdata and World Bank WDI database

Key sector characteristics and recent developments

7.67. The Bulgarian pharmaceutical market is one of the smallest in EU, but it has grown substantially over the past few years. The market reached BGN2,098 million in 2011 (Table 7.12), 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 7.12: 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>Total</td>
<td>2,097.7</td>
<td>1,875.9</td>
<td>1,719</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>1,824.6</td>
<td>1,600.5</td>
<td>1,400.4</td>
</tr>
<tr>
<td>Hospitals</td>
<td>273.1</td>
<td>275.4</td>
<td>254.9</td>
</tr>
<tr>
<td>OTC</td>
<td>338.6</td>
<td>294.9</td>
<td>262.4</td>
</tr>
</tbody>
</table>

Source: IMS Health (2012), estimates by the author.

7.68. 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, Chaiapharma, Bu-Bio, the National Center for Hematology and Transfusion, Inbiotech, Biomedia 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 7.13: Top 15 Pharmaceutical Companies in Bulgaria

<table>
<thead>
<tr>
<th>Company</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>Sofarma</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.

7.69. 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.

7.70. The Pharmaceuticals sales sector is one of the most profitable sectors in Bulgaria (Table 7.14).

Table 7.14: Leading Trade Companies in terms of Profits (2010)

<table>
<thead>
<tr>
<th>Sector</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>Pharmaceuticals 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</td>
<td>5</td>
<td>38 530</td>
<td>5.4%</td>
<td>503 898</td>
<td>3.8%</td>
</tr>
</tbody>
</table>

Source: Official data by Central Bank and National Statistical Institute, publication by ICAP Group (2012), 300 Business Leaders in Bulgaria.
*FMCG – fast-moving consumer goods
**EBITDA – earnings before interest, taxes, depreciation and amortization.
7.71. 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.

7.72. 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. Chereva 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.

7.73. In terms of manufacturing, Sopharma JSC is the leading drug producer in Bulgaria (Table 7.15). 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 distributers 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.

109 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 JSC is 33rd with BGN41.1 million (13.8 percent change).
Table 7.15: Leading Producers of Drugs and Products

<table>
<thead>
<tr>
<th></th>
<th>EBITDA  (000 BGN)</th>
<th>Profitability (%)</th>
<th>Trade Revenue (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>BalkanpharmaDupnitsa 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>
<tr>
<td>BalkanpharmaTroyan JSC</td>
<td>6 160</td>
<td>19.8</td>
<td>31 098</td>
<td>7 312</td>
<td>7.7</td>
<td>0.2</td>
<td>330</td>
</tr>
</tbody>
</table>


Figure 7.3: BG Exports of Pharma Products Increased in 2009

7.74. 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.

7.75. 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.

7.76. 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.\textsuperscript{111} 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.\textsuperscript{112}

7.77. Overall, the Bulgarian pharmaceutical industry generates only about 25,000 jobs,\textsuperscript{113} of which about 3,000 are in R&D, research, and clinical trials.\textsuperscript{114} 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.\textsuperscript{115} The majority of studies undertaken by Bulgarian companies remain focused on proving bioequivalence between generic and patented drugs.\textsuperscript{116}

7.78. 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**

7.79. The Bulgarian pharmaceutical industry faces three main sets of challenges:\textsuperscript{117}

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\textsuperscript{111} See, Héctor Hernández from the Joint Research Centre at the EC. See the ranking of companies as per R&D investment, available at: http://iri.jrc.ec.europa.eu/research/docs/2010/SB_2010_BXL_17-11-2010.pdf.

\textsuperscript{112} 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).

\textsuperscript{113} 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.

\textsuperscript{114} 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.

\textsuperscript{115} 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.

\textsuperscript{116} 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.

\textsuperscript{117} 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
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). 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


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.
7.80. 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{119} There are several reasons for this, including the deficient program implementation, specifically at the stages of selection and reimbursement.\textsuperscript{120}

7.81. 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 7.5).

\begin{center}
Box 7.5: High Potential for Commercialization of Research Activities - Department of Chemical Engineering (DCE) of the Sofia University Faculty of Chemistry and Pharmacy
\end{center}

\textit{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.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure}
\caption{Low Shear Rates and High Shear Rates}
\end{figure}

\textsuperscript{119} 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{120} Interviews with grant applicants from the pharmaceutical industry and supporting research institutes and universities.
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 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).

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**

7.82. 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](image)

**Source:** IBM Business Consulting Services.

7.83. 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).
7.84. 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.

Source: Baden-Württemberg.

7.85. 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

7.86. 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 whom are partnering 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;**
- **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 7.16: 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</td>
<td>- Limited experience in R&amp;D associated with new drug development and early stage clinical trials activities</td>
</tr>
<tr>
<td></td>
<td>- Limited connectivity of Bulgarian research</td>
</tr>
</tbody>
</table>
trials leveraging the presence of multinational pharmaceutical companies

- High export volumes of generic drugs to markets in Western Europe, Russia and CIS and the Middle East

<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>
<tr>
<td></td>
<td>- Lack of transparent regulation and procedures for early stage clinical trials</td>
</tr>
<tr>
<td></td>
<td>- Third countries’ informal competition, parallel imports of generic drugs</td>
</tr>
<tr>
<td></td>
<td>- Brain-drain of qualifies researchers engaged in collaborative R&amp;D due to low salaries in Bulgaria</td>
</tr>
</tbody>
</table>

IV. Information and Communications Technology Sector

Key sector characteristics and recent developments

2011 EU sector snapshot\textsuperscript{121}

- 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

\textsuperscript{121}\textsuperscript{4}“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

Eurostat publicly available data, 2011

Project: BG161PO003-5.01-0033 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
• 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

7.87. 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). 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 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)

7.88. 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.

7.89. 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”. (see Box 7.6)

7.90. 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 eGovernment area, aiming to catch up to the EU leaders.

7.91. 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

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122 Broadband Quality Score 2009 (BQS); Invest Bulgaria Factsheets, InvestBulgaria Agency, 2011
key sub-segments - computer programming, consultancy and information service activities, represent respectively 14 percent and 6 percent of the sector revenue.

<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>
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<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>
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<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 Arbitus 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>
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<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>
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<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>1 362</td>
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<td>13 Inter Consult Bulgaria (Sofia)</td>
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<td>5 196</td>
<td>4 397</td>
<td>744</td>
<td>97</td>
<td>80</td>
</tr>
<tr>
<td>14 Nemetheck (Sofia)</td>
<td>15.98</td>
<td>6 460</td>
<td>5 570</td>
<td>561</td>
<td>114</td>
<td>104</td>
</tr>
<tr>
<td>15Cisco systems Bulgaria (Sofia)</td>
<td>13.81</td>
<td>13 195</td>
<td>11 594</td>
<td>953</td>
<td>83</td>
<td>91</td>
</tr>
<tr>
<td>16 NDB (Sofia)</td>
<td>8.64</td>
<td>7 762</td>
<td>7 145</td>
<td>3293</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>17 Networks Bulgaria (Rousse)</td>
<td>4.79</td>
<td>6 209</td>
<td>5 925</td>
<td>311</td>
<td>92</td>
<td>103</td>
</tr>
<tr>
<td>18 ICD soft (Sofia)</td>
<td>4.47</td>
<td>5 464</td>
<td>5 230</td>
<td>464</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>19 Microsoft Bulgaria (Sofia)</td>
<td>0.90</td>
<td>10 279</td>
<td>10 187</td>
<td>1 065</td>
<td>36</td>
<td>37</td>
</tr>
</tbody>
</table>

Source: "The Most Dynamic SMEs in Bulgaria", Capital (2012) page 74

**Key challenges in the sector**

7.92. 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).  

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123 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 Hisarya on November 9-10, 2012 helped consolidate opinion about the challenges and opportunities for the ICT industry.

7.93. 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 e-lab 2010). 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. 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.

7.94. 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 7.6: Bulgarian business management solutions to the global market - Orak Engineering, Ltd. - Plovdiv

History and Development

ORAK Engineering Ltd. (Orak) is 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 engineer with a diploma from a Plovdiv University-Aberdeen University partnership. Back in 1996 together with a couple of close 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


126 Average salaries in the sector are significantly higher than in other industries.
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, Energy and Tourism, 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**

7.95. 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 Bourgas.

7.96. Employment is equally distributed among the three ICT subsectors, but telecom contributes 73 percent of revenues.
Table 7.18: 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>


7.97. 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.

7.98. 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 7.7).

Box 7.7: 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 status of ‘Preferred Partner’ to major buyers.
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.

Another 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.
ICB has been participating in a couple of international visits of the President of Bulgaria and the Minister of Economy, Energy and Tourism, where some interesting contacts with international companies were established. However, ICB has never been a beneficiary of national instruments or government programs for 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**

7.99. *The fields with highest technological innovation intensity in Bulgaria’s ICT sector, based on the number of patents* issued\(^{127}\):

- 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.

\(^{127}\)List of Bulgarian international patents, Bulgarian Patent Bureau, 2011
7.100. 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**

7.101. 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.

7.102. 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.

7.103. 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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128 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.
**SWOT ANALYSIS**

Table 7.19: SWOT Analysis for the Bulgarian ICT

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</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</td>
<td>- Inefficient system for the protection of intellectual property rights,</td>
</tr>
<tr>
<td>projects under (FP7)</td>
<td>specifically service innovation and business process innovations</td>
</tr>
<tr>
<td>- Active presence of top-multinational ICT companies, with</td>
<td>- Shortage of labor combining technical knowledge with business and soft</td>
</tr>
<tr>
<td>local R&amp;D and BPO centers</td>
<td>skill sets</td>
</tr>
<tr>
<td>- Rapidly increasing contributions of local companies in the</td>
<td>- Increasing brain drain due to relatively low salaries (from a global</td>
</tr>
<tr>
<td>highest value added market segments</td>
<td>perspective)</td>
</tr>
<tr>
<td>- Well-developed ICT infrastructure including high-speed</td>
<td></td>
</tr>
<tr>
<td>broadband.</td>
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</tbody>
</table>

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

**C. Conclusions and Recommendations**

7.104. 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.  

7.105. 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.

7.106. 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 percent. This leaves Bulgaria in an unfavorable position to compete in the increasingly knowledge-based global economy.

7.107. 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 labor costs, relatively low tax burden, proximity to and traditions in markets in the Middle East and the Former Soviet Union.

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130 Ibid.
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.

7.108. 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.

**Food Sector:**

- 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 remedied by creating a set of business incubators for each of the food processing segments i.e., wine making, processing of vegetables and fruits, dairy processing, meat processing, etheric oils production etc., or alternatively 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 sector segments (dairy, meat, wine, fruit/vegetables, bio products) as well as by technology transfer offices within 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 an expertise. In this context, all 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 centers, promote university spin-offs, young entrepreneurship and start-ups, as well as to promote successful ICT business sub-segments: BPO’s, shared services, data centers 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 way hinders human capital formation, and could potentially accelerate current “brain drain” trends that would negatively impact local innovation capacity.
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.

Source: The Observatory of economic complexity www.atlas.media.mit.edu

TheGoing for Smart Growth report 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.

131 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 7.10: 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
Focus group meetings with key sector representatives including business, academia, and government were held in October and November 2012 in collaboration with MEET.

I. 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

<table>
<thead>
<tr>
<th>№</th>
<th>Name</th>
<th>Institution</th>
<th>Position</th>
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<tbody>
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<td>1.</td>
<td>Assoc. Prof. Zarya Rankova</td>
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<td>2.</td>
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<td>3.</td>
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<td>4.</td>
<td>Margarita Dobreva</td>
<td>Eliaz Ltd</td>
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<td>Tobacco Institute</td>
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<td>11.</td>
<td>Prof. Argir Zhivondov</td>
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<td>13.</td>
<td>Lora Kapelovska</td>
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<td>Snr. Associate EU Projects Management</td>
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<td>Nikolay Nikolov</td>
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<td>15.</td>
<td>Mihaila Yarlyiska</td>
<td>Ministry of Finance</td>
<td>Economic and Financial Policy</td>
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<td>16.</td>
<td>Leylara Dovanova</td>
<td>MEET</td>
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II. 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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<th>Name</th>
<th>Institution</th>
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<tr>
<td>1</td>
<td>Emilia Radeva</td>
<td>MEET</td>
<td>Head of Department</td>
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<td>2</td>
<td>Emil Komatichev</td>
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<td>Anton Kanev</td>
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<td>Ioana Lazarova</td>
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<td>Dragan Peshinski</td>
<td>MRRB</td>
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<td>Ilia Leikov</td>
<td>Cluster Electro Mobiles</td>
<td>Chairman</td>
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<td>Venislav Slavkov</td>
<td>Cluster Mechatronics / Spesima LTD</td>
<td>Chairman / Executive Director</td>
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<td>15</td>
<td>Venislav Vanev</td>
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<td>Oskar-El LTD</td>
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<td>SAT LTD</td>
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<td>Bajko Novakov</td>
<td>Samel- 90</td>
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<td>Sasho Vajarov</td>
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<tr>
<td>24</td>
<td>Todor Neshkov</td>
<td>Technical university</td>
<td>Dean</td>
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</table>
III. 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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<tr>
<th>№</th>
<th>Name</th>
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<td>1.</td>
<td>Boris Stoichkov</td>
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<td>Krasimira Chemishanska</td>
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<td>Lubomir Chipilski</td>
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<td>Mariela Marcheva</td>
<td>Glaxo Smith Kline</td>
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<td>Momchil Vassilev</td>
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<td>ARRHarm</td>
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<td>Nelly Koseva</td>
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<td>22.</td>
<td>Venislava Marik</td>
<td>MZH</td>
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IV. The meeting of the Information and Communication Technology (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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<th>№</th>
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<tr>
<td>1.</td>
<td>Aleksandar Mihaylov</td>
<td>Betahouse</td>
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<td>2.</td>
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<td>Gergana Dimitrova</td>
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<td>4.</td>
<td>Daniela Pesheva</td>
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<td>7.</td>
<td>Diana Popova</td>
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<td>Dimitar Dimitrov</td>
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<td>Prof. Krasen Stefanov</td>
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<td>Krassimira Shindarova</td>
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<td>Prof. Rumen Nikolov</td>
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<td>24.</td>
<td>Sasha Bezuhanova</td>
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<td>Head of unit “Project management”, IT directorate</td>
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<td>CTO / Vice-president</td>
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<td>John Gabriel Goddard</td>
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<td>Senior Economist, Team Leader</td>
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<td>Feyi Boroffice</td>
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<td>Private Sector Development Specialist, Team Coordinator</td>
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<td>World Bank Consultant</td>
<td>Consultant</td>
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