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Innovation Performance Review

BELARUS

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United Nations Economic Commission for Europe

INNOVATION PERFORMANCE REVIEW OF BELARUS

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NOTE

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FOREWORD

The *Innovation Performance Review of Belarus* initiates a new focus of activity for the United Nations Economic Commission for Europe, which draws on the experience accumulated so far in the identification of good practices and policy lessons in the area of knowledge-based development.

Innovation in the modern economy is influenced by the decisions of numerous stakeholders and depends on a multitude of factors. Public policies have a significant influence on innovation performance. Public intervention is necessary not only for creating favourable framework conditions and stimulating innovative activities but also for encouraging cooperative actions by innovation stakeholders and putting in place institutions and policy mechanisms that address different market failures in the innovation process. An assessment of the national innovation system, which takes into account both the international experiences and the local needs, opportunities and constraints, is a basic precondition for the development of effective evidence-based policies.

This *Review* presents the main outcomes of a participatory policy advisory exercise undertaken at the request of the Government of the Republic of Belarus. It aims to provide a set of recommendations and policy options to stimulate innovation activity in the country, enhance its innovation capacity and improve the overall efficiency of the national innovation system. Close collaboration with the national authorities and other Belarusian experts throughout the project has helped in identifying issues of practical importance to policymakers and in ensuring the relevance of the *Review* conclusions and recommendations to national circumstances.

The *Review* aims to contribute to the existing body of policy-relevant analytical work on policies promoting innovative development, thus facilitating the further identification of good practices in this area. The assessments and recommendations presented in the *Review* will serve to identify areas in which capacity-building activities can yield greater benefit, thus providing a solid basis for future work in this direction.

I would like to thank the Government of the Republic of Belarus for its support in launching this pioneering initiative. I hope that the recommendations of the *Review* will provide useful guidance to policymakers and other innovation stakeholders in their activities and that the lessons learnt in this process are also of relevance to other UNECE Member States in their efforts to promote innovation.

Ján Kubiš
Executive Secretary
United Nations Economic Commission for Europe

PREFACE

The practical work on the *Innovation Performance Review of Belarus* began in June 2010 with a preparatory mission by representatives of the UNECE secretariat to establish contacts and discuss the structure and content of the *Review* with the national authorities and other stakeholders. The main project mission took place from 12 to 22 September 2010 with the participation of a team, including representatives of the UNECE secretariat, international and national experts.

The *Review* reflects the outcomes of a series of consultations and discussions between the *Review* team and Belarusian policymakers, government officials, representatives of academic institutions and the business community and other innovation stakeholders.

The draft text of the *Review* was submitted for comments to the Belarusian authorities and to a group of independent international experts who had not participated in the field mission. The main outcomes of the project, including its main conclusions and recommendations were presented and discussed during the Substantive Segment of the fifth session of the Committee on Economic Cooperation and Integration on 1 December 2010 with the participation of the *Review* team, the external reviewers, the members of a high-level delegation from Belarus and delegates from other UNECE Member States. In the course of deliberations, a number of delegates shared their high appreciation of the results of this pilot project, its relevance and usefulness for policymaking and commended the secretariat for undertaking it.

The final text of the *Review* was prepared for publication by the UNECE secretariat reflecting the outcome of these discussions as well as other comments and suggestions by different stakeholders.

ACKNOWLEDGEMENTS

The *Innovation Performance Review of Belarus* was prepared by a group of international and national experts as well as staff of the UNECE secretariat. The *Review* was the result of a collective effort in which the lead authors for each chapter were: José Palacín (chapter 1), Julia Djarova (chapter 2), Marina Ranga (chapter 3), Slavo Radosevic (chapter 1 and chapter 4), Anna Kaderabkova (chapter 5), Hannes Leo (chapter 6), Anna Pobol (chapter 7) and Christopher Athey (annex). Krzysztof Gulda, Malcolm Parry and Hans Wissema reviewed the first draft of the *Review* and provided useful proposals. During the discussion at the Substantive Segment of the fifth session of the Committee on Economic Cooperation and Integration, Nina Bohdan, Anatoly Hryshanovich and Ivan Solonovich presented comments and suggestions on behalf of the Belarusian delegation. Rumen Dobrinsky contributed to the overall editing of the publication.

UNECE would like to express its deep appreciation to the Eurasian Development Bank for its generous financial contribution which made possible the implementation of the project *Innovation Performance Review of Belarus*.

The project was undertaken in close collaboration with the United Nations Development Programme Office in Belarus which provided logistic support and contributed to the substantive work.

The smooth work throughout the project was greatly facilitated by the helpful support and cooperative attitude of the State Committee on Science and Technology of the Republic of Belarus which was UNECE's leading partner in Belarus in implementing this project.

CONTENTS

CONTENTS (continued)

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF FIGURES

LIST OF BOXES

ABBREVIATIONS

ALLEA	European Federation of National Academies of Sciences and Humanities
BelISA	Belarusian Institute of System Analysis
BIF	Belarusian Innovation Fund
BNTU	Belarusian National Technical University
BRFFR	Belarusian Republican Foundation for Fundamental Research
BYR	Belarusian Rouble, national currency
CERN	European Organization for Nuclear Research
CIS	Commonwealth of Independent States
CMMSPS	Centre for Monitoring the Migration of Scientific and Pedagogical Staff
CNRS	National Centre for Scientific Research (France)
CPA	Classification of Products by Activity
EAPO	Eurasian Patent Organization
EBRD	European Bank for Reconstruction and Development
ECA	Eastern Europe and Central Asia
EIS	European Innovation Scoreboard
ERAWATCH	European Commission's European Inventory of Research and Innovation Measures
EurAsEC	Eurasian Economic Community
EPO	European Patent Office
FDI	Foreign Direct Investment
FEZ	Free Economic Zones
GDP	Gross Domestic Product
HES	Higher Education Sector
IAAS	International Association of Academies of Sciences
IAEA	International Atomic Energy Agency
IAP	Global Network of Science Academies
ICHMT	International Centre for Heat and Mass Transfer
ICOMES	International Congress of Mechanical Engineering Societies
ICSTI	International Centre for Scientific and Technical Information
ICSU	International Council for Science
ICT	Information & Communication Technologies
IFC	International Finance Corporation
IP	Intellectual Property
IPR	Intellectual Property Rights
ISCED	International Standard Classification of Education
ISIC	International Standard Industrial Classification of all Economic Activities
ISCO	International Standard Classification of Occupations
ISL	Industry-Science Linkages
ISTC	International Science and Technology Centre
ITA	International Technical Assistance
IUPAC	International Union of Pure and Applied Chemistry

NABS	Nomenclature for Analysis and Comparison of Science Programmes and Budgets
NACE	Nomenclature Général des Activités Économiques dans le Communautés Européennes
NASB	National Academy of Sciences (Belarus)
NCIP	National Centre for Intellectual Property
NCU	National Coordinating Unit
NIO	National Information Office
NIS	National Innovation System
NPITC	National Programmes of International Technical Cooperation
NTBF	New Technology-Based Firms
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
RCTT	Republican Centre for Technology Transfer
RIS	Regional Innovation Systems
RTD	Research & Technological Development
RTNN	Russian Technology Transfer Network
S&T	Science and Technology
SPID	State Programme for Innovative Development
SCST	State Committee on Science & Technology (Belarus)
SITC	Standard International Trade Classification
SME	Small/Medium-Sized Enterprise
SNA	System of National Accounts
TRIPS	Trade-Related Aspects of Intellectual Property Rights
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
WIPO	World Intellectual Property Organization

EXECUTIVE SUMMARY

The *Innovation Performance Review of Belarus* provides a critical examination of the national innovation system, the institutional framework of innovation policy and the various mechanisms and instruments of public support for innovation in the country. On the basis of this broad assessment, a number of policy options and recommendations are offered to improve the innovation performance of the country and enhance the innovation capacities of stakeholders.

Assessment

National innovation system and innovation governance

The term "national innovation system" (NIS) characterizes the systemic interdependencies within a given country, which influence the processes of generation and diffusion of innovation in that economy. There is a broad awareness and recognition of the importance of innovation for future growth and competitiveness of Belarus by the authorities. As a result, substantial efforts have been made to organize the institutional element of the national innovation system. There have been also important steps to create essential elements of the innovation infrastructure.

However, the focus has been largely placed on the administrative (institutional) element of the NIS rather than on the links and interactions between different subsystems (e.g. business, science, education, infrastructure). The prevailing understanding of the notion of innovation in Belarus, which is also embodied in the policy domain, puts the main emphasis on science-based technological innovation. As a result, this narrows the scope and coverage of the policy measures that fall into the domain of "innovation policy" in Belarus.

The present NIS and innovation governance are mostly oriented towards sectors and industries (the so-called vertical approach). This has been a good departing point but the system at present seems to be overloaded with institutions, programmes and, consequently, quite cumbersome. Even more importantly, such an approach is not instrumental for the establishment of efficient horizontal interactions (e.g. multi-disciplinary, cross-sectoral, cross-departmental), which are essential in a modern NIS.

The analysis of the national innovation system of Belarus indicates that the entrepreneurial sector is one of its weaker parts. A fast growing small and medium-sized enterprises (SME) sector, in particular innovative, high-risk enterprises, is needed to ensure sustainable and vibrant economic growth. SMEs provide important complementarities to the innovative activities of large firms.

The emergence of a vibrant entrepreneurial sector and the commitment to innovation requires not only administrative support and economic incentives but also a cultural shift in the

attitudes of the population. The strong support received by innovation at the highest policy level is a good start to communicate these priorities in a powerful way to a wider population.

At present there are some mismatches in statistical methodologies and practices in Belarus compared to most European countries, in particular, regarding statistics on innovation performance. Such discrepancies prevent direct international comparisons of Belarus innovation performance with that of other countries, both at the macro and micro levels. Ensuring international comparability of such statistical data is very important for benchmarking and national policymaking.

Framework conditions, innovation policies and instruments

Belarus has accumulated valuable experience in establishing framework conditions conducive to innovation, although with a relatively limited scope of application. The experience of the Belarusian High Technology Park is a typical example of this sort. Science parks also enjoy special privileges. The fact that such policies are only applied to limited parts of the NIS, results in the formation of favoured "enclaves", with reduced incentives for their residents to graduate.

State funding plays an important role in channelling resources for innovation activities in Belarus. The increased use of competitive procedures to allocate these resources is a positive development that has increased the efficiency of spending decisions. However, it is important that policies encourage not only competition between applicants for state resources but also reward cooperative arrangements, in particular, with the participation of SMEs.

Belarus has developed a wide range of initiatives to foster innovation, including the State Programme for Innovative Development for 2007-2010, which is due to be followed by a new programme for the period 2011-2015. Such a complex and far-reaching set of measures provides a significant scope for drawing lessons from past experiences. This could make an important contribution in increasing policy effectiveness, while taking into account national circumstances.

The regional dimension of innovation policies is an important consideration, which is recognised in the current policy set-up. In addition, innovation policies can contribute to a more balanced regional development and the correction of regional disparities. This acknowledgement is a good starting point for a further strengthening of the policy linkages between innovation and regional development issues.

Knowledge generation and innovation support institutions

Belarus has preserved engineering competencies in large enterprises, capabilities in the research and development (R&D) sector and a skilled labour force. The country has also displayed a strong capacity for policy implementation. However, the concentration of R&D in research institutes and the relatively limited role of enterprises in this area are at odds with the experience of more developed countries. Such a situation is not conducive to the development of strong innovation capabilities at the enterprise level.

A possible reorganization of the R&D system could seek to create organizations with a coherent set of activities (commercial or public), that are viable in the medium term and can maintain and develop competencies in their core areas. The main direction of such reforms could be towards the integration of R&D activities into the business enterprise sector.

The current R&D system is excessively oriented towards the commercialization of R&D results, to the point that it possibly undermines scientific excellence. The existing top-down coordination mechanisms of setting research priorities seems to reduce the room for scientific initiative that deviates from these priorities. While in the short and medium term it may be beneficial to integrate different types of R&D activities (basic, applied, development, engineering), this approach may also affect negatively research and innovation capacity in the long-term.

Somewhat paradoxically, the current system of supporting innovation activity contains strong incentives towards investment and technical modernization but is weaker in the promotion of innovation proper. The public finance rules in state science and technology programmes apply uniformly to projects which are often not 'innovation projects' but modernization projects. Moreover, the rules strongly discourage risk taking by the recipients of state funding which results in perverse incentives that favour technically proven projects and thus reduce innovation ambitions. Innovation support has become entangled with investment in modernization through a broad mixture of programmes funded through sectoral innovation funds.

Belarus is a catching-up economy that will remain dependent on imported technology for some time to come. One of the key factors for sustained and knowledge-driven economic growth is the efficient international technological integration and/or cooperation with leading foreign partners in innovation processes. Addressing these issues will require greater economic opening, the promotion of technology acquisition through trade, subcontracting and foreign direct investment (FDI), and facilitating the integration of domestic innovation stakeholders in global innovation chains.

Foreign direct investment, which has increased in recent years, has a strong potential to raise technological capabilities and facilitate the participation of Belarusian enterprises in the global networks through which knowledge is disseminated. Future FDI, including from neighbouring countries, will depend on general factors such as improvements in the business environment and the strengthening of integration processes in the region. However, complementary policy measures will be necessary to attract science-intensive investment and ensure that the potential benefits of FDI are maximized.

Industry-science linkages and collaboration in the innovation process

Regulations concerning the relations between industry and science in Belarus tend to emphasize legal and administrative aspects and address to a lesser extent the incentives of innovation stakeholders to engage in innovation projects. Policy efficiency to spur innovation activity could be raised by introducing economic mechanisms to encourage the commercial exploitation of R&D results. Administrative guidance cannot substitute economic incentives to ensure the dynamism of the innovation system. The knowledge creators should be able to

profit from their innovation efforts, as this creates the necessary incentives to promote commercialization. In turn, public research organizations need also to develop internal rules that promote the commercialization of their outputs and upgrade their competencies to deal with these matters.

Some types of R&D activities in Belarus seem to be disconnected from the needs of the industry; likewise the rewards for such research. This situation partly stems from the established practice of setting both the agenda and plans of research institutions, which is not always linked to industry demand and is therefore not conducive to closer collaboration with the industry. Continued and consistent policy efforts are required to ensure a better connection between the two subsystems.

Technology transfer is a complex matter that requires the creation of dedicated support institutions and a system of incentives that encourages academic staff to be involved in the commercialization of research outputs. Technology transfer activities may be a source of revenues for research institutions but this should not be the primary concern and needs to be balanced against other objectives. The authorities can provide a wider range of support measures that facilitate the efforts of research institutions.

New technology-based firms play a key role in linking science and industry, as they are nimble, ready to explore possibilities in a flexible way and provide opportunities for entrepreneurial initiatives originating in the academic and research world. There is wide scope for promoting the emergence of such firms in Belarus and stimulating their growth and integration in the economy.

Financing innovative entrepreneurs

Financing is a critical dimension of the innovation process, especially as regards the early entrepreneurial stage. Access to external finance is crucial for growth and a major constraint if not available in sufficient quantity. This is an area which is still underdeveloped in Belarus. Availability of equity finance (stock market, business angels, venture capital) will be increasingly relevant as the catching-up process matures. A functioning banking sector and related support structures that create conducive framework conditions and sufficient funding for investment are also important ingredients of any development strategy.

The system of public support to innovation and provision of entrepreneurial finance in Belarus has a built-in feature of strong risk aversion. While the concern to ensure an appropriate use of the funds is understandable, it is also true that no radical innovation can take place without risk. Public support is critical precisely because the public sector can take more risks than private operators and can therefore explore more opportunities for the benefit of the society at large. This understanding needs to be reflected in the design and functioning of financial support mechanisms.

Belarus runs a large number of programmes that aim to foster innovation. In some cases, they promote technological investments rather than genuine innovative efforts. Distinguishing between investment- and innovation-based development processes is important for the organization of support structures. The outcome of investment projects is easier to predict

than that of genuine innovation projects so they are better suited to be supported through the banking system. Public support may be warranted if the banking system does not supply sufficient funding or discriminates against certain types of investments or investors (SME, exporters, service sector companies, etc.). By contrast, there is a need to expand the scope and to diversify the instruments for support to genuine innovation. Equity participation in innovative projects as a specific form of early stage financing implies sharing of risks, including the possibility of losses.

Simplicity is an important feature of any innovation support system. The present system in Belarus is already quite complex and may be a challenge to deal with, in particular for private sector participants. At the same time, it is very articulated as regards the expected outcomes in terms of specific products or achievements. Successful innovation is inherently difficult to predict. While the definition of state priorities may be an important component of the guidance role provided by the public sector in the innovation process, it is important that other potential areas of innovation are not neglected. In the current system innovation activities that were not foreseen by the administration and therefore remain outside these programmes, are difficult to materialize.

Innovation and international economic integration

Belarus is a small open-economy for which success in external markets is a necessary dimension of its innovation performance. However, internationalization is a significant challenge for companies and should be supported by policy measures facilitating international trade in science-intensive goods and technologies. In particular, special attention needs to be given to export-oriented SMEs, for which barriers to trade are the most significant.

Recently, a number of new initiatives have promoted wider and broader international economic cooperation within regional integration structures, such as the Commonwealth of Independent States (CIS) and the Eurasian Economic Community (EurAsEC). Such initiatives provide a nurturing ground for closer cooperation in science and technology and joint innovation projects. The potential for this type of cooperation is reinforced by shared history and language, a common scientific and education legacy and traditionally strong economic links. Institutional and personal contacts with organizations and researchers in other CIS countries are another source of strength that needs to be nurtured.

The institutional framework for international science and technology collaboration has been gradually developed in Belarus in recent years, through the efforts of the public authorities and other innovation stakeholders. However, there is not yet an integrated strategy for international cooperation that duly emphasizes the international dimension of innovation processes.

Effective international cooperation calls for wide participation of innovation stakeholders supported by dedicated structures. Public efforts can play an important role in helping the different actors of the national innovation system to overcome the coordination, financial and organizational hurdles that prevent stronger interaction with potential foreign partners.

There is a range of existing possibilities for international scientific cooperation which depend on successful applications for technical aid. However, this potential is not yet fully used due to shortcomings in capacity and the lack of appropriate incentives for these types of activities.

International mobility of Belarusian scientists and their active participation in international projects are essential to ensure that they can keep abreast of the latest scientific innovations and develop the personal and institutional networks through which scientific knowledge is disseminated. Belarus has made important efforts in creating institutional relations with foreign partners but continued attention in this area is required, in particular, at the level of inter-personal contacts. Student mobility is also important to facilitate knowledge-sharing and the generation of new ideas. At the same time, permanent migration of scientists abroad may have negative implications for domestic scientific capabilities. Policies should recognize this potential downside and adopt measures that on balance increase the benefit of international mobility.

Recommendations

A number of recommendations and policy advice can be derived from the assessment of the innovation performance of Belarus which could contribute to increasing the efficiency of the national innovation system and enhancing the innovation capabilities of stakeholders. These recommendations, which concern a large number of innovation related issues, have different scope, including strategic considerations, changes in the allocation of resources, new policy orientations or the design of specific instruments. In some cases, the recommendations are proposed as invitations to explore new policy directions with the help of pilot projects and suggestions regarding the institutional structure.

In order to improve the functioning of the **national innovation system**, the *Review* recommends a critical assessment of the innovation policy mix in Belarus to compare its coverage with other countries and identify mismatches. This assessment should lead to a broader understanding of innovation that is not limited to technological aspects.

It is proposed that weak or missing links between the various components of the national innovation system be targeted through strategic measures. Implementation plans for proposed reforms should pay attention to sequencing aspects, focusing initially on improvements that are more likely to have a positive impact in the short term, thus creating space for further interventions. The horizontal approach in innovation policies need to be strengthened, thus contributing to the development of linkages. This direction could be supported by an appropriate institutional structure, such as newly created National Innovation Council, with the participation of all key innovation stakeholders.

The analysis of the national innovation system has identified an underdeveloped SME sector as a key weakness, which could be addressed through a variety of measures, in consultation with entrepreneurs while seeking to tap into the potential of R&D and academic institutions as sources of innovative entrepreneurship. Awareness campaigns could promote the necessary cultural changes towards higher recognition of the role of entrepreneurship. Public measures should support the involvement of SMEs in cooperative arrangements and various types of partnerships, including their participation in state science and technology programmes.

There are positive experiences encouraging innovation in science and technology parks as well as in special economic zones. The favourable conditions, including tax holidays and other incentives, applied to these enclaves could be extended to the whole economy, thus improving the general **framework conditions for innovation**.

Building on past achievements, the authorities could devote further efforts to develop the regional dimension of **innovation policies**. This may include initiatives to increase the scope of existing programmes and ensure better coordination with other regional actions. Such an approach would benefit from complementary actions to strengthen the capacity of regional innovation stakeholders and encourage mutual cooperation.

While evaluation procedures are already part of the Belarusian policy cycle, a more comprehensive evaluation of the outcomes of past policy initiatives and measures, and the extent to which they meet the policy objectives and targets, would be advisable. This may include independent international evaluation to identify weaknesses, potential to be developed as well as areas of international excellence to be supported.

A possible shift towards an enterprise-based innovation system would increase the effectiveness of the system of **knowledge generation** and diffusion. The reintegration of R&D activities into the business enterprise sector should be voluntary, gradual and agreed with key stakeholders. Implementation could take place on the basis of a number of pilot projects that develop and carry out restructuring plans for specific organizations.

In order to facilitate this restructuring and the emergence of institutions with a consistent set of activities, policies should be developed to strengthen the linkages between universities and R&D institutes. Basic research groups could be integrated into universities. Some R&D institutes could be reoriented to serve the needs of the emerging technology-intensive SME sector (in the manner of the German Fraunhofer institutes). Facilitating labour mobility in the R&D sector would ease the costs of adjustment.

Reforms in the system of public funding of R&D could contribute to preventing the erosion of scientific excellence through commercialization pressures. This may include differentiating between various types of R&D and diversifying the system of funding, which should reflect not only top-down guidance but also demand generated by other innovation stakeholders.

Policies, instruments and **innovation support institutions** need to distinguish clearly the support to innovation activities (where risk is an intrinsic part of the process), from support to investment in modernization. Changes in this area would require a re-examination of the mechanism of innovation support (in particular those practiced by sectoral innovation funds) against international and domestic good practices. New instruments should recognize that risk taking is an inherent feature of the innovation process. Cross-border technology transfer and inward diffusion of knowledge and innovation could be promoted through policy measures that link incentives granted to foreign direct investment (FDI) and/or inward subcontracting to innovation objectives. The participation of Belarusian innovation stakeholders in global innovation chains needs to be further encouraged. Support to SMEs should be given to facilitate the establishment of long-term supplier relationships with larger enterprises, both domestically and abroad.

Foreign direct investment can make a significant contribution in raising the innovation potential of the economy and provide access to new technologies and organizational practices. In order to enhance this positive impact, the authorities could consider extending the competencies of the National Investment Agency to include innovation-related and technological issues.

The clear allocation of intellectual property rights in the innovation process is important to facilitate the involvement of domestic and foreign investors, and, more generally, to encourage innovation activity and facilitate **industry-science linkages and collaboration in the innovation process**. The authorities could consider the introduction of the practice of allocating intellectual property rights to the performing research organization while ensuring that individual researchers or research teams can share in the rewards (royalties). Other initiatives in this area could include guidelines for internal intellectual property policies, plus training and support to the emergence of innovation brokers.

The internal incentives for commercialization could be reinforced through policy mechanisms that stimulate direct channelling of industry R&D demand into the work plans of R&D institutions, without necessarily passing through state science and technology (S&T) programmes. Evaluation and appraisal procedures of research activities should take into account the desire to foster linkages between industry and science.

Technology transfer could be facilitated by strengthening incentives for entrepreneurial behaviour within the academic and research community, supporting the formation of public-private partnerships to fund R&D efforts and encourage the development of the professional services that can assist technology transfer. New technology-based firms, sometimes established on the basis of academic spin-offs, contribute to developing the links between industry and science. Targeted measures to foster the development of these companies could facilitate their integration in the economy.

Actions to address the challenge of **financing innovative entrepreneurs** work better when combined with other measures to encourage innovation. There is a need to introduce a variety of instruments, including subsidized loans, innovation grants/vouchers and guarantee schemes for eligible recipients/innovators. Public initiatives should also target the development of a well functioning private infrastructure of early stage financing. Overall, the existing system of public support needs to accept an increased level of risks and be more tolerant of failure. This could lead to the introduction of a non-repayable grant scheme and the specification of conditions under which existing penalties for failure will not apply.

There is a need to reconsider and re-focus the existing instruments for public support to innovation projects to take into account different types of risks involved in different types of projects. Public support should be concentrated in areas of high risk or where there are particular difficulties in access to finance, as in the case of SMEs. This differentiation could be reflected in the type and design of financial instruments used. Specialized financial institutions (rather than public bodies) could run these schemes targeting high risk activities. The Belarusian Innovation Fund could be developed and reorganized to serve these functions.

The system of financial support to innovation needs to be streamlined and differentiated from support to modernization investment, where risks are low. A general purpose innovation programme, with no specific technological focus, could be developed to ensure that the system remains open to new possibilities.

In order to foster **innovation and international economic integration**, the authorities should encourage the internationalization of companies engaged in knowledge-intensive activities, including measures to promote exports and facilitate access to imports, as both are channels for the diffusion of innovation. Barriers, such as certification and standards, need to be addressed and particular support given to develop capacities in SMEs. The state procurement system could be used as a domestic testing ground prior to entry in foreign markets.

Integration processes in the CIS can foster scientific and innovation capabilities. This potential should be developed through practical initiatives that seek to share resource and information in the economic space and promote the creation of international scientific research centres following the model of the International Innovation Centre of Nanotechnologies of the CIS countries. The authorities could contribute to an international policy dialogue on the establishment and further development of common innovation support schemes and programmes providing financial assistance for the undertaking of international S&T and innovation projects within the CIS or EurAsEC.

The development of an integrated and coordinated strategy for international science and technology cooperation would complement and enhance existing innovation policies. This strategy could be overseen by a specialized Agency or Office for International Science and Technology Cooperation. Innovation stakeholders could receive targeted support to develop their international networking activities, in particular regarding foreign technoparks, technology transfer centres and educational institutions.

The possibilities offered by technical aid in support of scientific international cooperation could be used more extensively. In addition to the simplification of the national approval procedure and its eventual abolition, the conditions and incentives for technical cooperation could be improved. Possible initiatives include direct support to research organizations to develop the necessary skills, the introduction of compensation for project preparation and tax advantages on income accruing from participation in small projects.

The participation of Belarusian scientists and students in international knowledge networks could be promoted through further simplification of associated procedures and continued support to their involvement in activities such as international conferences, study opportunities and internships abroad. Links with Belarusian scientists working abroad could be strengthened though special schemes.

A taxonomy of recommendations: developing a strategy for implementation

The recommendations presented here are very varied, have different significance and can be carried out within different time horizons. Any decision on implementation would need to consider questions on optimal sequencing and the relations between various types of interventions. To this effect, table 1 presents a taxonomy of the *Review* recommendations

taking into account their differing nature and scope. At the more general level, some proposals concern general strategic directions that may be then followed up with more specific interventions. There are also suggestions that cover framework conditions or which suggest additional assessments as a prior step before deciding on future actions. Other recommendations concern the design of policies and the shape of specific instruments. Finally, a number of proposed interventions have been grouped according to their aim: raising awareness, developing networks, capacity-building and creation of institutions.

Table 1. Recommendations of the Innovation Performance *Review* of Belarus

Type of recommendation	*Review* recommendations
Strategic issues and basic approaches	• Broaden the scope of innovation policy, including non-technological aspects more fully (2.1) • Develop and implement a horizontal strategic approach to address innovation policy issues (2.3) • Promote entrepreneurship, including that originating from R&D and academic institutions (2.4, 5.2) • Recognize and accept that risk is an inherent process of the innovation process (4.4, 6.2) • Streamline state-run innovation programmes, distinguishing between technology-oriented, mission-oriented and general purpose programmes (6.4) • Develop further the regional dimension of innovation policies, including better coordination of regional innovation programmes with other regional initiatives (3.4) • Shift the strategic orientation of innovation policy towards an enterprise-based innovation system and develop a restructuring strategy for the R&D sector on the basis of this approach (4.1) • Encourage the internationalization of companies engaged in knowledge-intensive activities (7.1) • Take full advantage of the potential of integration processes in the CIS to foster scientific and innovation capabilities, promoting initiatives on the sharing of resources and the development of joint initiatives and programmes (7.2) • Develop an integrated and coordinated strategy for international science and technology cooperation (7.3)
Framework conditions	• Extend favourable conditions existing in science and technology parks and other special benefits to the whole economy (3.1) • Create better incentives for innovation through clear allocation of intellectual property rights to performing institutions, while ensuring that researchers share the rewards (5.1)

Table 1. Recommendations of the Innovation Performance *Review* of Belarus *(continued)*

Type of recommendation	*Review* recommendations
Assessment	• Identify and address any missing or weak links in the National Innovation System (2.2) • Identify existing barriers to the emergence of new technology-based firms and the growth of existing ones (5.4) • Make extensive use of evaluation procedures to increase effectiveness and identify weaknesses, strength and potential (3.3) • Re-examine the rationale of the system of sectoral innovation funds (4.4)
Policy design	• Integrate R&D activities into the business enterprise sector, allocating basic research into universities and reorienting some R&D institutes towards serving the needs of technology-intensive SMEs (4.2) • Reform the system of public funding of R&D, differentiating according to type of research and diversifying modalities of funding (4.3) • Separate clearly support to innovation (riskier) from support modernization in the design of policies and instruments (4.4, 6.3 and 6.4) • Link incentives granted to FDI and/or inward subcontracting to innovation objectives (4.5) • Introduce technological considerations in privatization plans (4.6) • Encourage the direct channelling of industry R&D demand into the work plans of R&D institutions, without going through the intermediation of state programmes (5.2) • Support the emergence and development of new technology-based firms and their integration into the economy (5.4) • Facilitate the development of an infrastructure for early-stage private financing (6.1) • Design new forms of public support for venture capital financing (6.3) • Address certification, standards and other barriers that restrict trade (7.1) • Use the state procurement system as a testing platform for innovative technologies at an early-stage of development (7.1)
Instruments	• Develop guidelines for internal intellectual property rights policies in R&D performing institutions (5.1) • Introduce new evaluation criteria for publicly-funded research that takes into account its application in industry (5.2) • Introduce new policy instruments such as subsidized loans, innovation grants/vouchers and guarantee schemes for eligible innovators (6.1) • Introduce a grant scheme to explore ideas, independently of success (6.2) • Introduce criteria which specify conditions under which penalties for failure in publicly-financed innovation projects would not apply (6.2) • Facilitate a more extensive use of technical aid possibilities, through the simplification of approval procedures, the development of skills and the creation of better incentives through direct compensation and tax treatment (7.4)

Table 1. Recommendations of the Innovation Performance *Review* of Belarus *(continued)*

Type of recommendation	*Review* recommendations
Awareness-raising	• Launch a campaign to promote a new attitude towards entrepreneurship, innovation and risk-taking among the general population (2.5) • Increase awareness of a broader concept of innovation policy (2.1)
Network-building	• Support cooperative arrangements and partnerships in innovation activities, in particular with the participation of SMEs, facilitating their access to state programmes (3.2) • Strengthen the collaboration of regional innovation stakeholders (3.4) • Facilitate the participation of Belarusian innovation stakeholders in global innovation supply chains (4.5) • Provide targeted support to innovation stakeholders to develop and increase their international networking activities (7.3) • Encourage the participation of Belarusian scientists and students in international networks, through different form of supports, which target also the preservation of links with the Belarusian scientific diaspora (7.5)
Capacity-building	• Increase the innovation capabilities of SMEs and prepare them to establish long-term supplier relationships with larger companies (4.5) and to enter foreign markets (7.1) • Support training of stakeholders involved in the commercialization of intellectual property rights (5.1) • Develop supporting services in technology transfer and financing (5.1, 5.2)
Institution-building	• Create a National Innovation Council to target horizontal links in the NIS (2.3) • Extend the competencies of the National Investment Agency to cover also innovation-related and technological issues (4.6) • Create specialized financial institutions (replacing the role of public bodies) to provide financial support to genuine, risky innovation projects. This could be done on the basis of the existing Belarusian Innovation Fund, which could also be the channel to finance a general purpose innovation programme (6.3) • Create a specialized Agency or Office for International Science and Technology Cooperation to oversee a strategy for international science and technology cooperation (7.3)

Chapter 1

RECENT ECONOMIC AND INNOVATION PERFORMANCE

Belarus is a small, open, upper-middle income economy.[1] The country is not well endowed with natural resources. It largely relies on imported energy and raw materials and has a historical specialization in processing. The main activities of its significant industrial sector are engineering (agricultural technology and specialized heavy vehicles), and refining (which relies on oil supplies from Russia). These sectors depend heavily on external demand. Trade openness is one of the highest in the region, with a ratio of merchandise exports to GDP of 44% in 2009.

The disintegration of the former Soviet Union was accompanied by a sharp contraction in output, resulting from the loss of external markets and economic dislocation. The contraction in Belarus was, however, somewhat milder in comparison to the other successor States of the Soviet Union, as domestic policies continued to support demand and managed to reduce the impact of the post-Soviet economic dislocation. Following a cumulative 40% output decline in the period 1990-1995, the economy returned to growth in 1996, ushering a phase of rapid expansion during which Belarus posted one of the best performances in the CIS. In 2000-2004, real GDP grew by an average annual rate of 6.8%, accelerating to 9.6% in the period 2005-2008. Despite a less favourable external environment, as a consequence of the worldwide financial crisis and changes in trade relations with Russia, the economy continued to grow in 2009, albeit at a much reduced rate of 0.2%.

The Belarusian authorities have followed a path of gradual transition towards the market economy. The State retains significant levers of influence over the economy and privatization of large enterprises has been limited. The authorities have developed initiatives in recent years to improve the business environment and promote the development of small and medium enterprises. In addition, privatization options are also being considered. However, state companies continue to dominate production and exports, while the rate of new firm creation remains low.

1.1 Economic structure

Belarus has a well-developed industrial base that has been a major factor in the recent economic performance. Real industrial output more than doubled between 2000 and 2008. Its share in GDP has remained remarkably stable over the last decade, increasing from 26.5% in 2000 to 28.0% in 2008. As a consequence of the crisis, it shrank to 25.3% in 2009 (table 2).

Machine-building and metal processing is the main subsector (table 3), accounting for 21.5% of output in 2009, followed by fuel industry (19.4%), food processing (17.9%) and manufacturing of chemical and petrochemical products (12.1%). The bulk of the machine-

[1] GDP per capita in 2009 was around $12,800 on a PPP basis and $5,200 at current exchange rates.

building sector is concentrated in the city of Minsk, where it represents 51.9% of the total industrial output.

Table 2. Composition of GDP, shares in per cent, 2000-2009

	2000	2005	2006	2007	2008	2009
GDP	100	100	100	100	100	100
Industry	26.5	28.4	28.1	27.1	28.0	25.3
Agriculture	11.6	7.9	7.9	7.5	7.9	7.8
Services	0.5	0.5	0.6	0.5	0.5	0.4
Construction	6.4	6.9	8.0	8.5	9.3	10.7
Other goods	0.6	0.6	0.5	0.6	0.5	0.5
Services	41.7	42.8	42.7	43.2	40.9	44.0
FISIM	-1.8	-1.1	-1.2	-1.6	-1.6	-2.8
Net taxes and subsidies	14.5	14.0	13.4	14.2	14.5	14.1

Source: National Statistical Committee of the Republic of Belarus, Statistical Yearbook, 2010.

Table 3. Composition of industrial output, shares in per cent, 2000-2009

	2000	2005	2006	2007	2008	2009
Total	100	100	100	100	100	100
Mining	4.8	3.1	2.4	2	1.6	1.8
Electric power	7.1	6.2	5.9	6.3	5.5	6.8
Fuel industry	16.2	21.7	21.8	20.4	21.3	19.4
Ferrous metallurgy	2.9	3.7	3.6	3.9	4.1	3.2
Non-ferrous metallurgy	0.1	0.1	0.2	0.2	0.3	0.3
Chemical and petrochemical industry	12.5	11.3	11.2	11.6	13.4	12.1
Machine building and metal processing	20.5	22.4	23.8	24.5	23.2	21.5
Wood processing and paper	5	4.8	4.4	4.7	4.4	4.1
Building materials	3.4	4.2	4.3	4.6	5.1	5.5
Light industry	8.4	4.7	4.4	4.1	3.6	4
Food processing	17.3	16.2	15.9	15.3	14.6	17.9
Others	1.8	1.6	2.1	2.4	2.9	3.4

Source: National Statistical Committee of the Republic of Belarus, Statistical Yearbook, 2010.

Industry is also the main source of employment, accounting for 25.8% of the total in 2009, down from 27.6% in 2000 (table 4). Machine-building and metal processing is the largest subsector in terms of employment, representing 35% of total industrial employment, while accounting for 21.5% of total industrial output. Industrial employment represents a large share

of total employment and, unlike observations in most countries with economies in transition, has not fallen. Large enterprises continue to keep service functions in-house.

Over the period 2000-2009, the aggregate share of the services sector in GDP declined slightly to 40.9% from 41.7%. Sectors with rising shares in total employment include construction, trade and public catering and transport. The share of employment in services with more direct relevance for innovation performance remained stable (e.g. the communications sector), or declined slightly (education and science and science services). In terms of employment, the gains in the relative importance of the services sectors were mirrored by the losses observed in agriculture, with a share of employment that shrank from 14.1% to 9.5% between 2000 and 2009. For administrative purposes, the country is divided into six regions and the city of Minsk. Around 36% of total employment is concentrated in the city of Minsk and its region.

Table 4. Employment by sectors, shares in per cent, 2000-2009

	2000	2005	2006	2007	2008	2009
Total	100	100	100	100	100	100
Industry	27.6	27.0	26.7	26.9	26.6	25.8
Agriculture	14.1	10.5	10.2	9.8	9.4	9.5
Forestry	0.7	0.8	0.8	0.7	0.7	0.7
Construction	7.0	7.8	8.1	8.3	8.7	9.1
Transport	5.8	6.0	6.1	6.1	6.3	6.2
Communications	1.4	1.5	1.4	1.4	1.4	1.4
Trade and catering	11.0	12.7	13.3	13.6	14.0	14.2
Material and technical supply and sales	0.8	0.7	0.6	0.5	0.4	0.4
Housing and communal services	4.2	4.6	4.6	4.6	4.5	4.6
Non-productive personal services	0.5	0.8	0.8	0.8	0.9	1.0
Health, sports and social security	7.3	7.5	7.4	7.3	7.2	7.2
Education	10.4	10.4	10.3	10.1	9.8	9.6
Culture and arts	1.8	1.9	1.9	1.9	2.0	2.0
Science and science services	1.0	0.8	0.8	0.8	0.8	0.7

Source: National Statistical Committee of the Republic of Belarus, Statistical Yearbook, 2010.

1.2 The public sector

The public sector plays a dominant role in the economy of Belarus. In 2009, 47.5% of employment was provided by the State. Current official statistics underestimate the importance of the public sector, as they consider as private any company which is not fully state-owned. According to the EBRD,[2] the share of the private sector in GDP (in this case

[2] EBRD (2009), Transition Report, London.

only including companies where the private stake is higher than 50%), was 30% in 2009. The private sector remains underdeveloped in comparison with other economies in the region.

The influence of the government over the economy remains extensive, including not only direct ownership of enterprises but also administrative intervention in credit allocation and widespread subsidies. Large state-owned enterprises receive indicative output targets, a practice which has contributed to the stabilization of economic activity despite falling demand during the 2008-2009 financial crisis.

The budget system concentrates and allocates resources to various state sponsored programmes through a number of instruments. Revenues of the consolidated budget, which includes the republican budget, local budgets and a number of budgetary funds, represented 48.8% of GDP on average in the period 2007-2009. In 2009, tax revenues amounted to 30.2% of GDP. Local budgets account for around one third of consolidated revenues. Public finances have been run conservatively, although the slowdown in 2009 resulted in the emergence of a small deficit equivalent to 0.7% of GDP.

Control over state-owned banks has been used to channel loans to state enterprises under various state programmes. The banks have also benefited, when necessary, from liquidity support by the National Bank of Belarus on non-commercial terms. By the end of 2009, this type of financing accounted for around half of the total stock of banking loans (see chapter 6).[3]

Large scale privatization has been limited so far. While privatization revenues rose in 2007-2009, this was largely explained by the sale of a 50% stake in Beltransgaz to the Russian company Gazprom for $2.5 billion, which has been paid in instalments over this period.

In recent years, new initiatives have been introduced that point towards a relaxation of the state presence in the economy. In March 2008, the "golden share", which allowed the government to influence the management of privatized enterprises in which it retained only minority participation, was discontinued. The system of state support is also being reformed, in particular regarding industrial enterprises. State support is allocated to a larger extent on the basis of competitive funding and is linked to enterprise performance.[4] In addition, there have been discussions regarding the creation of a separate financial agency that would manage loans already disbursed under these programmes, so as to put existing banks on a more commercial basis and facilitate privatization.

1.3 Economic performance

The economy has expanded rapidly over the last decade, posting one of the best performances in the CIS. The drivers of growth have changed over this period (table 5). While in the period

[3] BNP Paribas, Deutsche Bank, The Royal Bank of Scotland, Sberbank, Belarusbank (2010), Prospectus for the U.S.$600,000,000 Bond Issue of the Republic of Belarus.
[4] World Bank (2010), Belarus Industrial Performance Before and During the Global Crisis, Belarus Economic Policy Notes: Note No. 1.

2001-2004, the contribution of domestic demand and net external demand to growth were roughly balanced, consumption and, in particular investment, have been the main sources of economic dynamism in the most recent period. By contrast, net external demand has been acting as a drag on growth.

Table 5. Contributions to GDP growth, shares in per cent, 2005-2009

	2005	2006	2007	2008	2009
GDP growth	9.4	10.0	8.6	10.2	0.2
Consumption	7.3	6.6	7.0	9.1	0.0
Investments	4.7	8.4	5.2	8.1	2.9
Net exports	- 14.4	- 7.9	- 1.5	- 9.4	1.5
Inventories and discrepancy	11.8	2.9	- 2.1	2.5	- 4.2

Source: IMF, Belstat and own calculations.

Economic expansion has been accompanied by a significant investment effort, with fixed capital rising at a compound annual rate of 17.8% in 2005-2009. As a result, the share of gross fixed investment in GDP rose from 26% to 37% of GDP over this period. This is significantly higher than observed in other countries in the region. In terms of its contribution to GDP growth in 2005-2009, gross fixed investment accounts for 86% of the cumulative GDP growth in this period.

High levels of fixed investment have been supported by directed lending to state enterprises. The global economic crisis and the reduction of directed state lending in 2010, in line with the agreement with the IMF, resulted in a slowdown of fixed investment.[5]

However, this strong economic performance has been accompanied by mounting external imbalances, reflecting a large savings-investment gap. A large current account deficit has emerged in recent years, rising from 8.7% of GDP in 2008 to 13.1% in 2009. This has been partly financed through external public borrowing and the accumulation of public debt, which more than doubled to reach 32.6% of GDP by the end of 2009.

The rapidly expanding industrial sector has been the main source of economic dynamism in Belarus, with industrial output almost doubling between 2000 and 2008. There have been some marked differences in the performance of industrial sub-sectors in recent years, which suggest an increased importance of resource-based activities. The fuel industry expanded at an annual average rate of 10% during the period 2001-2009, while the growth rate of the chemical and petrochemical sub-sector accelerated to 14.0% from 6.5%. By contrast, growth in the machine building sub-sector decelerated to 0.6%, down from 12.4%. In particular, there has been a trend towards the concentration of the sources of industrial growth in a handful of companies in chemicals, petrochemicals and metals. The oil processing sector accounted for 20% of industrial growth during the period 2005-2008.

[5] IMF (2009), Republic of Belarus: First Review Under the Stand-By Arrangement, Washington D.C., IMF.

Economic expansion has been supported by growing capacity utilization rates, which have been boosted by state quantitative targets. According to the World Bank, increases in capacity utilization can explain around one quarter of observed industrial growth in 2003-2008.[6] Average labour productivity has also increased rapidly, rising by 9.3% annually in the period 2005-2008. However, aggregate trends, taking into account the most recent data, point to a slowdown in productivity growth.

While real wages remained flat in 2009, they had been increasing very rapidly in recent years, fuelling the growth of consumption but outstripping productivity and eroding competitiveness. Over the period 2001-2008, wages in industry increased 2.64 times while labour productivity rose 2.13 times.

Nominal monthly wages are around $350 in 2009 but there are significant differences across sectors. While they are around 70% of this average in education, it is science and scientific activities that command the highest wages, being around 40% higher than the average.

Price regulation has been quite extensive, but the range of goods and services subject to price controls was significantly reduced in 2009. Consumer price inflation accelerated in 2007 and 2008, due to higher energy and food prices, reaching an annual rate of 13.1% by the end of 2008, but it has declined since. Control over producer prices has been generally less strict than over retail prices. These differences in the regulatory regime favoured manufacturers in comparison with services. In 2009, the previous practice of monthly ceilings for price increases and the requirement to register prices for new goods were lifted.

1.4 Labour force and education

Similarly to other countries in the region, Belarus faces demographic challenges. A declining overall population will eventually result in a shrinking and ageing labour force. However, the fall of the economically active population was halted in 2005, amid a booming economy. The activity rate has steadily increased in the period 2005-2009, reaching 64.6% by the end of this period. This has been accompanied by the growth in the number of employed people. Total employment rose by 4.2% in 2000-2009.

The State exerts a degree of influence in the allocation of labour resources, including through administrative controls over wage setting. A university graduate who has completed a government financed education programme has to accept a public job offer and stay in the post for two years.

Belarus has a well educated labour force. The level of public spending on education is high in comparison with neighbouring countries, although it has been declining in recent years as a percentage of GDP. In 2009, the ratio of education expenditures in the consolidated budget to GDP reached 4.9%, down from 6.0% in 2006. The share of spending on education in overall budget expenditures declined, reaching 10.6% in 2009 from 12.9% in 2006.

[6] World Bank (2010), Belarus Industrial Performance Before and During the Global Crisis, Belarus Economic Policy Notes: Note No.1.

The gross enrolment rate in tertiary education is very high, reaching 73% in 2008, according to UNESCO data.[7] The number of new students in higher education rose by 8% over the period 2005-2009. While the bulk of new students seek to pursue studies in law, economics and management (the three disciplines accounted for 38% of the total in 2009), the appeal of technical subjects is also high, accounting for 20% of student intake in 2009; up from 18% in 2005. Science and technology graduates represented 26% of the total in 2008, but only 2% were involved in science disciplines, which is rather low in comparison with other Central and Eastern European countries. Over the last decade, the number of new students in vocational training institutions has declined, albeit a reversal of this trend has been observed in the most recent data. Belarus does not officially participate in the Bologna Process.

Business surveys have started to identify shortages of skilled labour as a growth constraint, following years of rapid economic expansion. The World Bank/EBRD Business Environment and Enterprise Performance Survey 2008/2009 shows that the perception of skills shortages as a constraint to growth in 2005-2008 increased more sharply than in any other country in the region. Formal training offered to employees by companies is much lower than the average in Central and Eastern Europe.

1.5 International economic relations

Belarus is an open economy, where external trade has a significant influence on economic performance. The Russian Federation is the largest single exports market, accounting for around one third of total exports while the EU absorbed 43.6% of total exports in 2009. Russia is the largest source of origin of imports, reflecting the importance of oil and gas, which account for more than one third of total imports.

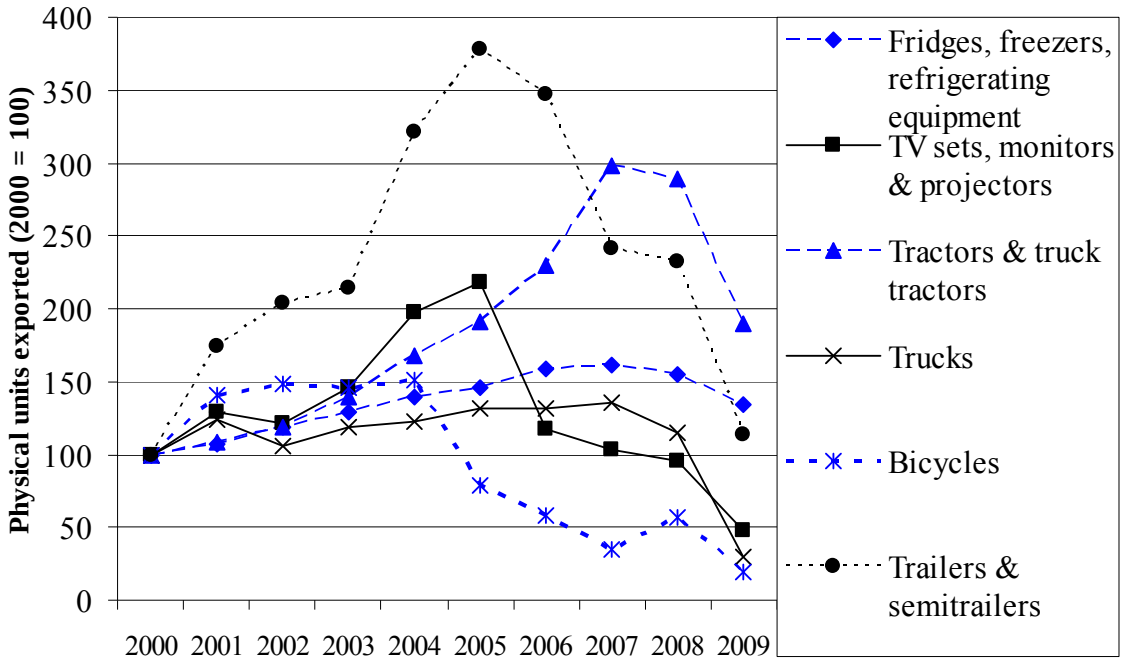
Oil products, fuels, petrochemical and mineral products accounted for 37.5% of total exports in 2009, being by far the largest exporting group. The high share of oil products in a country without its own resources is a rather unusual pattern. In addition, Belarus is also a significant exporter of chemical products and agricultural and food products (12.4% and 10.8% of total exports, respectively, table 6). Other important groups are machinery and equipment, non-precious metals and transport vehicles. A handful of companies accounts for the bulk of exports. In 2008, the 20 largest exporters represented around two thirds of total exports.

A favourable external environment has been an important factor in the good economic performance observed before the 2008-2009 global financial crisis. Terms of trade improved by around 35% in 2000-2008.[8] Favourable prices for its main exports, including oil products and fertilizers, and special price agreements in the energy trade with Russia contributed to the fast expansion of trade. In 2007, a gradual shift towards market prices in the energy trade with Russian began. Although preferences in trade with Russia have been declining, they remained important. The implicit subsidies associated with the special price agreements with Russia were estimated by the IMF at $5.9 billion in 2007 and $8.2 billion in 2008.[9] The new oil

[7] UNESCO (2010), Global Education Digest, Paris, UNESCO.
[8] IMF (2010), Republic of Belarus. Selected issues, Washington D.C., IMF.
[9] IMF (2010), ibid.

supply arrangements with Russia as of January 2010 have contributed to the deterioration in the terms of trade.

Figure 1. Exports of Belarusian technology-based products, in physical units, 2001-2009



Source: Based on http://belstat.gov.by

Exports have grown rapidly over the last decade. The ability to sell in world markets is an important reflection of innovation performance. During the period 2001-2004, exports rose at an annual rate of 20.4% in current dollars, accelerating to an annual average of 24.1% in the period 2005-2008. However, in constant prices, export growth slowed down from 13.8% to 3.0% between these two periods. The dynamics in terms of physical volumes for selected products also confirm the picture of declining export performance (figure 1).

Figures regarding the composition of trade also suggest a mixed export performance, despite the growth in the value of exports. The share of manufacturing in total merchandise exports has declined, falling on average by around ten percentage points between 2001-2004 and 2005-2008. Overall, changes in the commodity structure of exports in both CIS and non-CIS markets suggest a lower degree of export sophistication (see chapter 7), with mineral products and chemicals accounting for an increased share of total exports (around 80% of the total in 2008). Trade with the EU-25 is dominated by oil and oil products and fertilizers. Stripping out these products, there has been little change in the relative importance of mutual trade between these two periods (around 19%).[10]

[10] World Bank (2010), Belarus. Trade Performance and Competitiveness, Belarus Economic Policy Notes: Note No.2, Washington, D.C, World Bank.

Table 6. Commodity Structure of Merchandise Exports, shares in per cent, 2001-2009

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	100	100	100	100	100	100	100	100	100
Agricultural produce	4.7	3.8	4.5	4.7	4.9	5.2	5.6	5.1	8.2
Foods	3.4	4.0	3.8	3.8	3.4	2.3	1.9	1.6	2.6
Mineral products	18.2	20.8	22.6	27.5	35.4	38.8	35.6	37.8	37.9
Chemicals	11.4	10.1	9.9	9.2	9.6	8.1	8.7	14.0	12.4
Wood and pulp & paper	4.2	4.2	4.4	4.2	3.5	2.8	3.1	2.3	2.2
Textile and apparel	10.4	9.1	8.4	7.4	5.9	5.0	4.6	3.5	4.2
Ferrous metals and ferro-products	6.3	6.4	6.9	7.7	6.7	6.6	7.0	6.9	6.0
Non-ferrous metals	1.3	1.7	1.4	1.1	0.8	0.9	1.0	0.8	0.9
Machinery and equipment	12.0	11.5	11.4	10.8	9.0	8.7	9.5	7.9	7.8
Vehicles	13.0	11.7	10.8	11.3	10.4	10.4	11.9	9.7	6.7
Other	15.1	16.6	16.0	12.2	10.5	11.1	11.0	10.3	11.2

Source: World Bank (2010), ibid.

Other figures, as shown in table 7, indicate that innovative or technology intensive products have faced declining competitiveness, resulting in a reorientation towards the domestic market, and away from the CIS. However, an encouraging development is the increased ability to penetrate non-CIS markets.

Table 7. Shipments of Belarusian innovative production by markets, 2003 and 2008

	Share of shipments (%)	
	2003	**2008**
CIS	**40.3**	6.3
Russian Federation	29.5	27.9
Domestic market	24.7	**40.9**
Other	5	24.9

Source: State Committee on Science and Technology (2009), Science, Innovation and Technology in the Republic of Belarus 2008, Statistical Book, Minsk.

The intensity of intra-industry trade, which allows countries to reap the rewards of specialization and is usually associated with technology transfer, declined over the period

2005-2008, in particular in trade with the most advanced countries.[11] These trends suggest that there has not been a significant improvement in export performance as a result of domestic innovation activities.

Export performance partly reflects a low degree of FDI, in particular, export-oriented FDI and hence a low level of inward technology transfer (see chapters 4 and 6). FDI so far remains limited and linked to privatization initiatives, including the purchase of a 50% stake in the pipeline operator Beltransgaz by Gazprom and the acquisition of BPS Bank by Sberbank. Net FDI rose strongly in 2007-2009 (table 8), increasing sevenfold in comparison to the three preceding years, on a balance of payment basis. This partly reflects a policy shift initiated in 2007 towards the creation of a more competitive and transparent business environment. However, increased inflows can be largely explained by the above mentioned large transactions. FDI in industry tripled over this period but remained very small, accounting for around 5% of the total in 2009.

The authorities are paying increased attention to the promotion of FDI and are considering new privatization initiatives. The Customs Union with the Russian Federation, which became operational in October 2009, and further efforts to improve the business climate could encourage further inflows.

Table 8. Foreign trade flows and FDI in Belarus, $ million, 2003-2009

	2003	2004	2005	2006	2007	2008	2009
Current account	-434.4	-1,193.3	435.5	-1,431.2	-3,037.6	-5,048.8	-5,929.5
Trade balance	-1,255.6	-2,271.8	-637.6	-2,269.0	-4,071.0	-6,111.2	-6,285.3
Merchandise exports	10,072.9	13,942.2	16,108.8	19,834.7	24,328.9	33,043.3	19,165.1
Merchandise imports	11,328.5	16,214.0	16,746.4	22,103.7	28,399.9	39,154.5	25,450.4
Foreign direct investment, net	170.3	162.5	302.5	351.0	1,770.0	2,143.4	1,325.7

Source: EBRD Transition Report Database.

1.6 Key features of the research and development (R&D) system

The Belarusian R&D system reflects the legacy of the Soviet past, as the business enterprise sector is not the major R&D performer, in contrast to what is typical in market economies. Only 12.8% of R&D personnel work in industrial enterprises. However, the R&D system is, in principle, largely oriented towards enterprises. It could be characterized as a system of R&D for, but not in the industry. This feature of the Belarusian system has remained its strong characteristic, despite the gradual transformation processes that are taking place.

[11] World Bank (2010), ibid.

Extra-mural R&D, rather than enterprise-based R&D, is the major source of R&D and new technology (see table 9). R&D is dominantly (71.45%) undertaken in extra-mural R&D organizations. More than half of all R&D organizations (53%) are located in the extra-mural R&D sector. Organizations' own funds account only for 27% of gross expenditure on R&D, being important only in ferrous metallurgy and machine building industries. The shift towards an enterprise-based R&D system has been very slow, with a gradual decline in the number of extra-mural R&D organizations and research scientists and engineers working there.

Table 9. R&D personnel by type of organizations, 2008

	Number	**Percentage**
Extramural R&D organizations	***19,032***	**60.5**
State organizations, including National Academy of Sciences	13,875	44.1
R&D institutes	5,157	16.4
Business Enterprise Sector	***9,154***	**29.1**
Industrial organizations	4,557	14.5
Design organizations (KTB)	4,041	12.8
Project construction organizations	165	0.5
Experimental organizations	21	0.1
Other commercial organizations	370	1.2
Higher Education Sector (HES)	***3,287***	**10.4**
Universities and other HES	2,208	7.0
R&D institutes of HES	822	2.6
KTB of HES	256	0.8
Other organizations of HES	1	0.0
Total	**31,473**	**100**

Source: National Statistical Committee of the Republic of Belarus (2010), Statistical Yearbook, own calculations.

Structural data show that the R&D system has undergone only gradual change (table 10), with the relative shares of the three key sectors (higher education, business enterprise and government) remaining largely unchanged in terms of employment and funding. At the same time, R&D employment increased by 5% in five years (2003-2008), or 0.98% annually. The share of gross expenditures on R&D in GDP remained stable at around 0.7% of GDP in the period 2001-2008. Government funding has remained roughly unchanged at around 0.37% of GDP. During this period, GDP rose very rapidly, so the stability of these shares is consistent with rapid increases in the amount of funding in nominal terms.

Table 10. R&D expenditures by sector, shares in per cent, 2002-2008

	Higher education	Business enterprise	Government
2002	16	51	33
2003	18	45	37
2004	19	44	37
2005	17	44	39
2006	18	39	43
2007	12	**61**	27
2008	14	54	32

Source: State Committee on Science and Technology (2009), Science, Innovation and Technology in the Republic of Belarus 2008, Statistical Book, Minsk.

In line with the overall structure of the economy, practically all R&D is conducted in state-owned organizations. This mono-structure and lack of ownership diversity constitute a growing challenge when seeking to increase the dynamism of the Belarusian R&D system.

The structure of the Belarusian R&D system by discipline is strongly dominated by technical sciences (table 11). This predominant position concerns all sources of funding (including state goal-oriented programs and general budgetary funding), with the partial exception of innovation funds (see discussion in chapters 4 and 6). Seventy eight percent of all R&D organizations in industry are in the machine-building sector, where own funds (61%) are larger than budgetary funds (36%) as a source of financing. This strong specialization could be an asset to exploit, provided that it generates increasing returns through clusters, spillovers and knowledge exchange. However, other disciplines, such as life sciences, which are increasingly important globally, are poorly represented.

Table 11. Intra-mural expenditures on R&D, BYR million and shares by discipline, 2008

Discipline	**BYR million**	**% share**
Natural sciences	125,764	13.07
Technical sciences	**681,115**	**70.78**
Medicine	45,419	4.72
Agricultural sciences	59,826	6.22
Social sciences	40,406	4.20
Humanities	9,831	1.02
Total	**962,361**	**100**

Source: State Committee on Science and Technology (2009), Science, Innovation and Technology in the Republic of Belarus 2008, Statistical Book, Minsk.

1.7 R&D outputs and innovation performance

The measurement of the contribution of R&D to economic growth is a challenging analytical task. Export performance, which was considered earlier (see also chapter 7), is an indicator of the success in transforming innovation efforts into competitive products. The number of international publications, patents and the information provided by Belarusian innovation statistics, including the dynamics of new technology based enterprises, can shed further light on innovation performance.

Scientific and technical articles

The performance of the Belarusian science system, as proxied by the number of scientific and technical journal articles, has deteriorated in recent years. This is similar to observations in other countries in the region, such as Ukraine and the Russian Federation (table 12.). This suggests a decreasing ability of the country's science system to participate in world scientific exchanges (see also chapter 7). In the long term, such a negative trend could lead to a deterioration of absorptive and diffusion innovation capacities through its impact on the quality of the education system. It would also undermine the domestic ability to monitor and be part of developments at the world scientific frontier.

Table 12. Scientific & technological publications and patents, annual change, 1995-2005

	Annual change (%)	
	Publications	**Domestic patents**
Belarus	-3.1	5.5
Czech Republic	5.5	1.0
Lithuania	9.5	-1.5
Slovenia	10.1	-0.3
Russia	-2.8	3.6
Ukraine	-2.0	-4.0

Source: World Bank Development Indicators 2010.

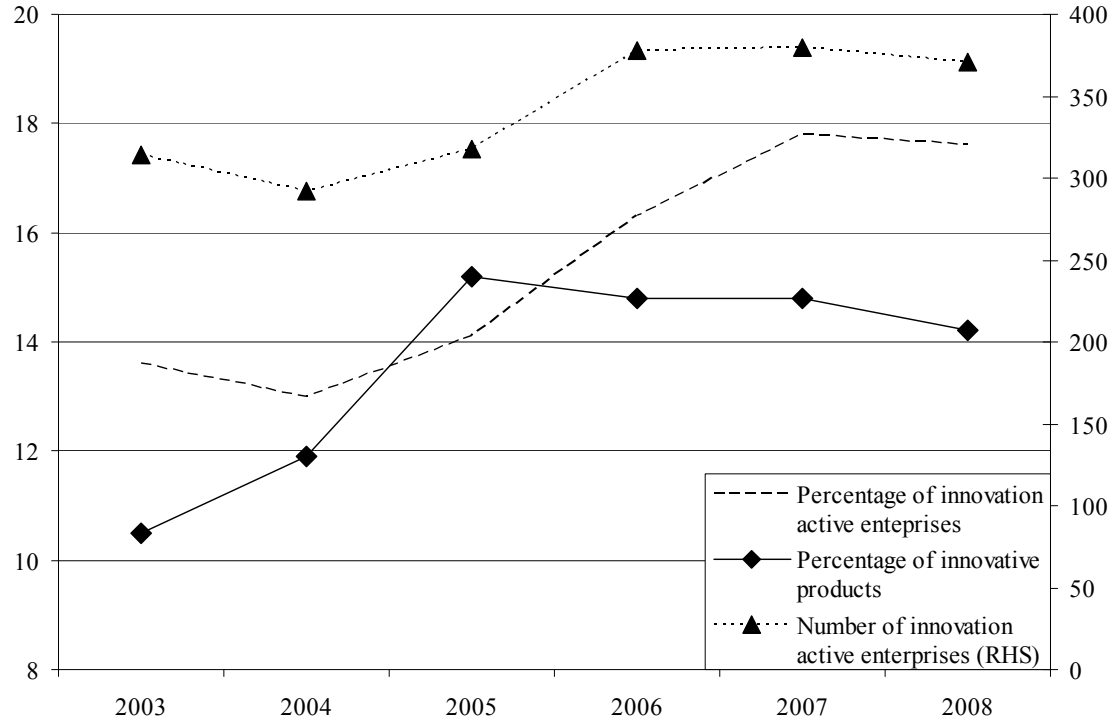
Patents

Patents are indicators of the output of the R&D system which are a much clearer expression of innovation activity than science and technology (S&T) papers. On the basis of this variable, Belarusian performance is much better, as figures show continuous increases in the number of domestic patents applications, up from less than 700 in the early 1990s to more than 1200 in 2007-2008. In contrast with what can be observed regarding scientific and technical journals, Belarus performs better on this dimension than some of the new EU member countries.

Innovation indicators in national statistics

Belarus has developed innovation statistics which reflect the specific features of the national economic system and have limited international comparability (box 1). Nevertheless, they help to portray the strengths and weaknesses of Belarusian innovation activities. The number and relative importance of innovative enterprises are growing, although from a low starting point. There were only 371 innovative enterprises in 2008[12]. However, the commercial relevance of innovation activities expressed as the share of innovative products in total products has stagnated since 2005 (figure 2). This coincides with indicators of export performance (see chapter 7) in high-tech products.

Figure 2. Innovation indicators of Belarus, in per cent, 2003-2008



Source: SCST (2009), Science, innovation and technology in Belarus 2008, Minsk.

Box 1. Statistical issues in measuring and comparing innovation performance

Belarus has a quite developed system of S&T and innovation statistics. Partly, this reflects the need to collect indicators to asses the implementation of state programmes in this area, on the basis of the targets defined. The shift toward a system where enterprises have increased autonomy and carry out a larger share of R&D would make this type of statistic less significant. For example, the focus of innovation statistics on counting 'objects' and covering transfer issues reflects the still strong administrative character of Belarusian innovation policy.

[12] These are "industrial enterprises which develop and/or introduce new or improved products, services or transfer methods, technological processes and other types of innovation activity", SCST (2009), ibid.

Box 1. Statistical issues in measuring and comparing innovation performance
(continued)

However, the Belarusian system of S&T and innovation statistics does not follow internationally agreed methodology in similar areas of statistical practice. This situation is regrettable, as it for example prevents direct comparisons with innovation performance of EU member states, where there is a well established tradition of measuring innovation performance for the purpose of benchmarking and international comparison. Thus, the European Innovation Scoreboard (EIS) provides an annual benchmarking of national innovation performance levels across a broad range of EU and non-EU countries based on a common methodology. The so-called INNO-Policy TrendChart provides cross-country analyzes (reflected in European Innovation Progress Reports), of major innovation policy trends based on comparable innovation indicators for the participating countries.

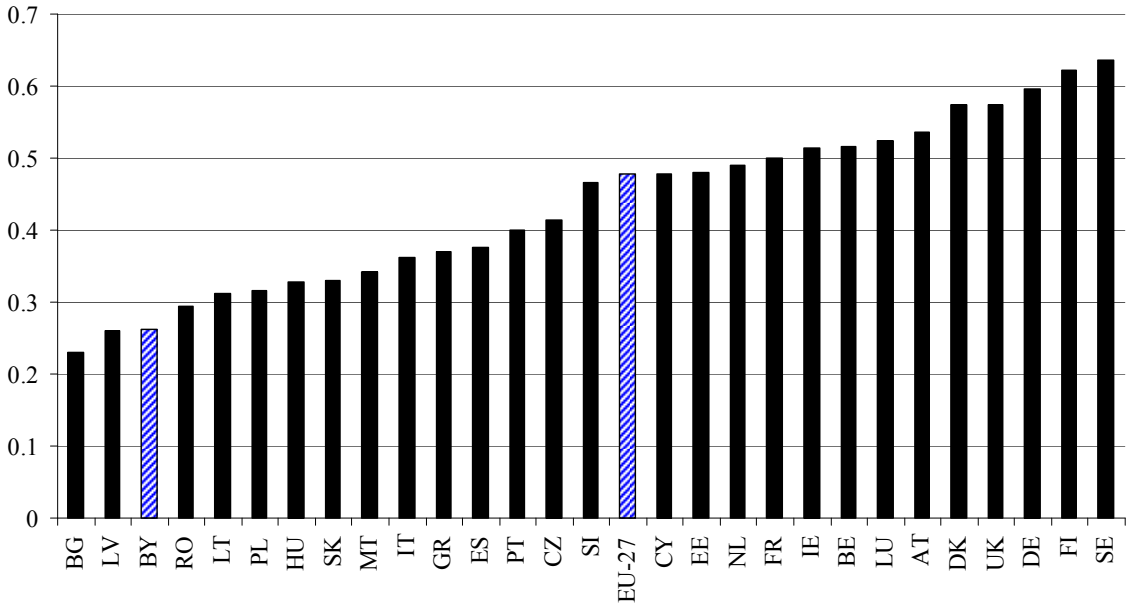
Within the EU and the OECD, there are some internationally agreed statistical methodologies and practices that member countries apply in measuring innovative performance which make international comparisons and benchmarking possible. The most important among them is probably the Community Innovation Survey undertaken by national statistical offices in EU member States. These are surveys of samples of firms which are based on a common methodological approach to measuring innovation (as defined in the so called Oslo Manual[i]), and include a range of characteristics of the innovation process at the firm level. Similarly, a number of countries undertake comparable surveys of research and development activities in accordance with the so-called Frascati Manual of the OECD.[ii]

The weak international comparability of innovation statistics is part of a broader statistical issue, as other components of the Belarusian national statistical practice – which is otherwise very well organized and functions almost perfectly – are also not aligned with internationally agreed and accepted methodological practices.

In order to improve the comparability of innovation indicators, the State Committee on Science and Technology (SCST) commissioned a study that aimed to estimate the position of Belarus against the European Innovation Scoreboard (EIS), used to compare innovative activity in EU member States (figure 3). This study was base on the methodology used in the EIS and supplied estimates in the absence of comparable data, when necessary. According to this indicator, Belarus belongs, together with Bulgaria, Latvia and Romania, to the group of catching-up countries with innovation performance well below the EU-27 average. Among the enablers dimension of the EIS, Belarus performs relatively well regarding human resources and public expenditures on R&D but access to finance presents problems. Other dimensions of the EIS concerning firms' activities and innovation outputs show weaker performance, thus reducing the overall score.[iii]

[i] OECD (2005), Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition, OECD, Paris.
[ii] OECD (2002), Proposed Standard Practice for Surveys on Research and Experimental Development, OECD, Paris.
[iii] N. Bohdan (2010), The sector of high technologies: methodological questions and perspectives of development, Belarusian Economic Journal, No. 3; N. Bohdan, Critical analysis of the level of innovative development of Belarus in 2010, research project commissioned by the SCST.

Figure 3. Estimates of Belarus' position in the European Innovation Scoreboard, 2009



Source: N. Bohdan, "Critical analysis of the level of innovative development of Belarus in 2010", research project commissioned by the SCST.

As in many catching-up economies, technological innovation in Belarus concerns mainly the purchase of machinery where intangible investments are complementary but not primary components (table 13). Data for 2008 show that machinery purchases and R&D accounted for 53% and 19%, respectively, of total innovation expenditures, which is quite high in comparison to similar economies.

However, the industry breakdown shows that 70% of innovation expenditure in ferrous metallurgy was R&D. If this sector is excluded, the share of expenditures on machinery would increase significantly, with a concomitant decline in R&D. This suggests that innovation in Belarus is to a large extent connected to the installation of new machinery and the effective use of this new equipment, rather than reflecting innovation as a knowledge-intensive activity. Intangible components of innovation expenditures like training, software and marketing research are, on average, somewhat marginal.

In addition to the focus on physical investment, a second important feature of innovation activities is that they are highly concentrated on a few industries. The four major innovating sectors are the fuel industry, machine building, ferrous metallurgy and the chemical and petrochemical industry. Altogether, they account for almost 80% of all innovation expenditures in the country. The main administrative units accounting for the bulk of innovation expenditures are the Ministry of Industry and the organization "Belnetfkhim" (petrochemical industry), which manage 76% of all innovation expenditures in the country.

Table 13. Innovation expenditures by category, shares in per cent, 2008

	With ferrous metallurgy	Without ferrous metallurgy
Machinery purchase	53.3	75.0
R&D	19.1	9.8
Engineering	8.5	12.4
Licences and patents	0.5	0.7
Software purchase	0.5	0.6
Training	0.1	0.2
Marketing	0.3	0.3
Other	17.8	12.4

Source: SCST (2009), Science, innovation and technology in Belarus 2008, Minsk.

In commercial terms, "innovation sales" or sales based on innovative products are concentrated in machine building and the metal processing industry (49.7% of all sales), and in the fuel industry (21.7%) (table 14). The importance of the machine building and metal manufacturing industry is closely connected with its weight in R&D expenditures and personnel.

Table 14. Shipped "innovative production" by industrial sector, shares in per cent, 2008

Industrial sector	Share, %
Machine-building and metal processing	**49.7**
Fuel industry	**21.7**
Chemical and petrochemical industry	9.2
Ferrous metallurgy	9.1
Food processing	3.8
Building materials	3.3
Others	3.3
Total	**100**

Source: SCST (2009), Science, innovation and technology in Belarus 2008, Minsk.

1.8 Recommendations

At present there are notable mismatches in statistical methodologies and practices in Belarus compared to most European countries, in particular, regarding statistics on innovation performance. Such discrepancies prevent direct international comparison of Belarus' innovation performance with that of other countries, both at the macro and micro levels. Ensuring international comparability of such statistical data is very important for benchmarking and national policymaking.

Recommendation 1.1

The authorities should continue efforts to gradually introduce a system of innovation and R&D statistics that is fully comparable with international definitions and procedures. During this transition, the existing system could be preserved to provide continuity with the past and attend to the needs of administrative economic management. Among the important components of internationally-accepted statistical methodologies and practices to measure R&D activity and innovation are the following:

- *Adoption of a R&D survey according to the OECD (2002) Frascati Manual, Proposed Standard Practice for Surveys on Research and Experimental Development;*
- *Adoption of the system of monitoring of Government budget appropriations for R&D; (GBOARD) which monitors budget spending on S&T based on socio-economic objectives;*
- *Introduction and harmonization of Innovation Survey Statistics based on the OECD/European Commission (2005) Oslo Manual, Guidelines for Collecting and Interpreting Innovation Data;*
- *Harmonization of Science and Technology Statistics with guidelines in the OECD (1995) Canberra Manual on the Measurement of Human Resources devoted to Science and Technology (S&T); and*
- *Benchmarking the scope within the framework provided by the Community Innovation Survey (CIS) 2008 that is used in the EU for statistics on innovation activities of enterprises.*

Recommendation 1.2

The recommended shift towards an internationally comparable system of innovation and R&D statistics should be part of a broader effort towards achieving a higher degree of international comparability of Belarusian statistics. In particular, in addition to the steps listed in Recommendation 1.1., achieving better comparability of the national innovation and R&D statistics will require the gradual introduction, harmonization or update of a number of major classifications which serve as a basis for S&T and innovation statistics:

- *SNA – System of National Accounts 2008, UN;*
- *ISCED – International Standard Classification of Education, UNESCO 1997;*
- *ISCO-08 – International Standard Classification of Occupations, ILO 2007;*
- *Classification of S&T fields (UNESCO/OECD), revision 2007;*

- *CPA - Classification of Products by Activity, UN, 2008;*
- *ISIC – International Standard Industrial Classification of all Economic Activities rev. 4, UN 2008;*
- *NACE – Nomenclature Général des Activités Économiques dans les Communautés Européennes (Classification of Economic Activities in the European Community) rev. 2, Eurostat, 2008;*
- *SITC –Standard International Trade Classification, rev. 4, UN, 2006;*
- *HS – Harmonized Commodity Description and Coding System, WCO, 2007*;
- *NABS – Nomenclature for Analysis and Comparison of Science Programs and Budgets, 2007; and*
- *Sectoral classification of R&D expenditures and personnel, which fully reflect sectors in the Frascati Manual.*

Chapter 2

NATIONAL INNOVATION SYSTEM AND INNOVATION GOVERNANCE

Chapter 2 is structured as follows. It starts with an introduction of basic concepts and notions used in the Innovation Performance *Review* such as National Innovation System (NIS) and innovation governance. These are used as the background for assessing the National Innovation System in Belarus and its governance. The analytical assessment makes it possible to draw some conclusions on the functioning of the NIS in Belarus and present some recommendations for possible policy measures aimed at enhancing the functioning of the NIS and the efficiency of innovation governance in Belarus.

2.1 Some basic notions used in the Innovation Performance *Review*

National Innovation System (NIS)

Innovation in the modern economy is a highly complex process. In accordance with the internationally agreed understanding of the notion of innovation, there are four broad types of innovation: product innovation; process innovation; marketing innovation and organizational innovation.[13] Each of these types of innovation may be associated with numerous different undertakings and can have various quantitative and qualitative performance characteristics. Besides, every product which is new to a given market is also usually considered and counted as an innovation, although the product might have been already introduced to other markets earlier.

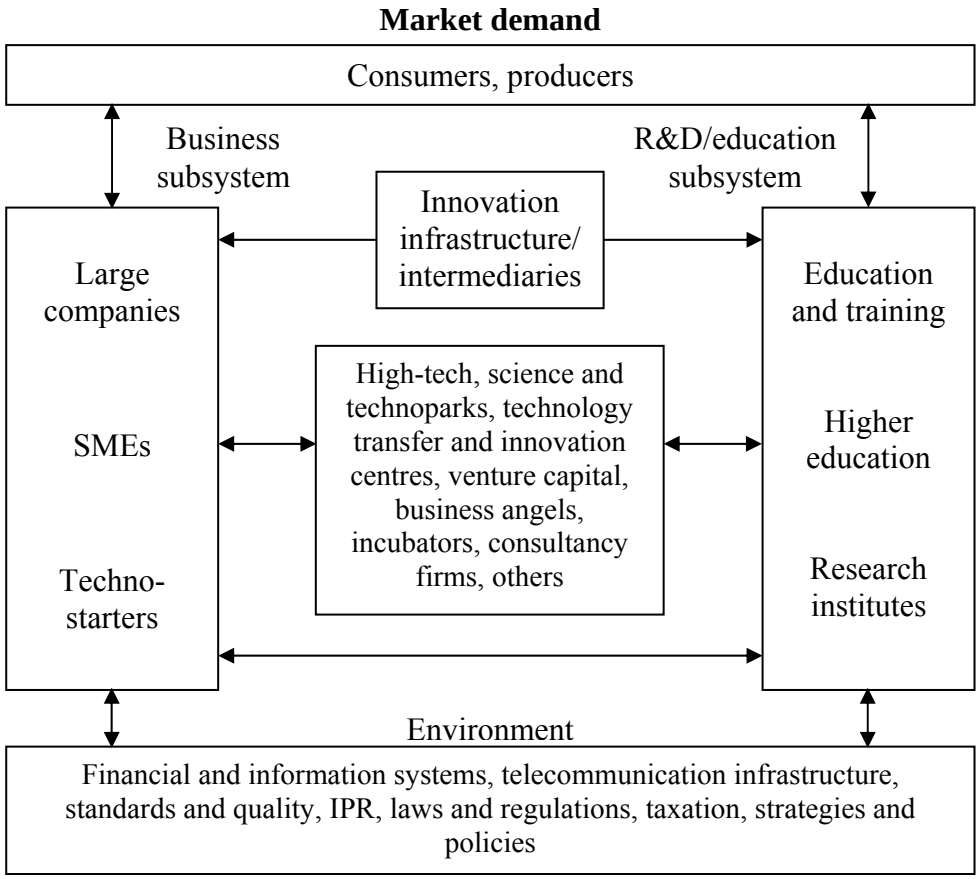
The term "national innovation system" (NIS) characterizes the systemic interdependencies within a given country, which influence the processes of generation and diffusion of innovation in that economy. This *Review* takes as a basis a broad definition of the NIS proposed, namely, that the NIS can be defined as: "*the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies*".[14] The base model shown on figure 4 illustrates the linkages between the main actors in the NIS. According to this model, research and education systems interact with companies in order to develop and transfer know how. Intermediaries play an important role in this transfer and so do the elements of the knowledge infrastructure. Market demand acts as the driving force for companies. If elements and links are missing, the innovation system lacks efficiency and speed of adaptation to new developments. Hence, it is important that public efforts are aimed at balancing the national innovation system, strengthening all subsystems and establishing and enhancing the links and inter-relationships between these

[13] As defined in the so-called Oslo Manual, which is the most comprehensive guide on "measuring" innovation activity and performance: OECD (2005), Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition, OECD, Paris.
[14] C. Freeman (1987), Technology Policy and Economic Performance - Lessons from Japan, London: Pinter Publishers.

subsystems. An innovation system approach can help to identify specific leverage points for the country in improving policy and performance in science and innovation.

In the last decade, quite some attention has been paid to the regional dimension in shaping innovation.[15] Regional Innovation Systems (RIS) follow the logic of the NIS in the terms of subsystems and inter-links between them. A point of attention though is that RIS's should not stay locked up in themselves; synergy between regions should provide a multiplicative effect at the national level.

Figure 4. Base model of the National Innovation System[16]



Both at the national and regional levels, three main actors play an important role: the public sector, the R&D sector and the enterprises.

In recent years, there have been certain shifts in the understanding of the relations between the main actors within the NIS, such as:

- Governments became more involved in enhancing innovation through appropriate institutional structures and policy measures;

[15] P. Cooke (2004), Regional Innovation Systems: An evolutionary approach, London, Routledge, 2004.
[16] Adopted from: C. Freeman (1987), National systems of innovation: the case of Japan, in: Technology Policy and Economic Performance, London, Printer Publishers.

- Universities and publicly funded R&D units have become increasingly important for corporate innovation; corporate R&D units and laboratories have reduced in scale and number. At the same time, fostering the linkages between industry and the research and scientific base are seen as an important policy target; and
- Commercialization of R&D from all sources has become a significant topic;
- New innovative firms and innovative SMEs have attracted growing attention from governments and the variety of incentives towards them has also increased.

The main challenge in improving a national innovation system is that it often consists of several inter-related subsystems. Therefore, the connectivity among them strongly affects the functioning of the NIS: poor linkages among subsystems may hamper the functioning of the NIS as a whole.

The interaction between two important subsystems, those of business and science, is at the core of the NIS approach. In many ways there are very clear differences between these two structures which is a major challenge in promoting interaction among them. This 'gap' is important and the related challenges and problems in bridging it are addressed in chapter five as well as overall in the *Review*.

While science seeks academic eminence and takes a long-term view, business seeks profit and market shares with a shorter term perspective. Science produces information in the public domain mainly through publications, while in the business sector information may be a resource to be used for commercialization. Bridging the gap between science and business (the main subsystems of the innovation system), has a positive effect on economic growth.[17]

Reducing this gap can be facilitated by intermediaries that constitute part of the innovation infrastructure. Intermediaries comprise institutions such as technology transfer centres, business and high tech parks, innovation centres, marketing and information centres, also consultancy firms, venture capital organizations, business angels and others. The innovation infrastructure consists of actors from both the public and the private sectors. The role of the public sector is to create favourable conditions for such infrastructure to develop and grow. In many cases, the public sector may also initiate a number of these intermediaries or create financial incentives for their establishment.

The subsystem of enterprises requires specific attention as entrepreneurship is a driving force of innovation.[18] Well functioning markets are essential for this driving force to be effective. Other important factors include the availability of R&D and the environment enhancing communication and collaboration of enterprises through means of, for instance, clusters, science parks, and others. An important feature of the subsystem of enterprises is the variety of firms that innovate. As SMEs are critical for a well functioning and dynamic market economy, innovative SMEs are an important policy target for many governments. SMEs are more nimble than larger enterprises and can explore new areas of activity, thus being an important engine of innovation. The increasing attention and efforts on commercialization of

[17] OECD (2001), The New Economy: Beyond the hype, Paris, OECD.
[18] J. Schumpeter (1934), The theory of economic development: An inquiry into profits, capital, credit, interest and the business cycle, Cambridge, MA, Harvard University Press.

science combined with entrepreneurship are driving the growth of spin-off companies from R&D and academic institutions.

An environment conducive to innovation should offer means that stimulate the links between different subsystems of the innovation system and remove the barriers to innovate. The role of the public sector in general is to intervene and correct whenever possible failures in the economic system. Elements of such an environment include the sources of financing for innovation, a system for the protection of intellectual property rights, standards and quality systems, access to information and communications technology (ICT), adequate legislative and regulatory setting as well as strategies and policies concerning R&D and innovation.

Access to finance is a key determinant of innovation. The part of the environment that provides funding is therefore essential. As R&D and innovation are associated with uncertainty and high risk, public sector intervention is a corrective instrument for related market failures. Commercial banks are, by definition, more risk averse. Private money that may cover risk such as business angels and venture capital (part of the innovation infrastructure), are usually insufficient. Many studies show that specifically targeted public subsidies may have a positive effect on the growth of enterprises, the speed of growth and networking and cooperation with others.

National innovation system vs. science and technology system

The national innovation system (NIS) perspective stands in stark contrast to the previous policy approach in many post-Soviet economies (including Belarus), which was primarily focused on the science and technology (S&T) system. It is important to distinguish between S&T activities, including research and development (R&D), and innovation systems. This is especially important from a policy point of view due to the fact that, in policy practice, innovation policy is sometimes erroneously considered as restricted to public support for R&D only.

From the NIS perspective it is important to recognize that while there is some overlap between R&D, S&T activities and innovation systems, there are also important differences. S&T activities are usually defined as:[19] "systematic activities which are closely concerned with the generation, advancement, dissemination, and application of scientific and technical knowledge in all fields of science and technology". These include activities such as:

- Research and experimental development (R&D);
- Scientific and technical education and training at broadly the tertiary level; and
- Scientific and technological services.

The S&T system is not identical to the innovation system. As pointed out earlier, the NIS is the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies. From this definition it follows that a NIS cannot be built from top down, but can be affected by public policy. Its inherent core

[19] UNESCO (1978), Recommendation concerning the International Standardization of Statistics on Science and Technology.

features include the knowledge flows and knowledge generation processes combined with the organizations in which they take place. The NIS is shaped by a variety of innovation activities which include not only R&D but also knowledge absorption, diffusion and generation of demand for new knowledge and technologies.

In this *Review* we analyze the Belarusian innovation capacity and its innovation policy from the perspective of a system of innovation. The NIS perspective has important implications for policy such as:

- Interconnection and interdependence are at the heart of the innovation system concept;
- The traditional view of the "linear innovation model" (from research to technology to commercial product), has given way to the currently dominant view that innovation results from simultaneous interactions of many agents interconnected in a complex system;
- Innovative activities are embedded in different forms (patents, people, equipment, organizational know how, etc.);
- Business enterprises are central actors in the system. Successfully innovating companies require internal R&D capacities;
- Innovation functions are distributed among different organizations;
- The innovation system is driven by both the supply of, and demand for, innovation;
- Innovation activities include a wide range of functions differing from R&D proper. E.g. design, engineering and management play key roles in innovation systems;
- National systems are internationally open; and
- Innovation policy is a balance – or 'mix' – between different principles, policies, mechanisms and instruments.

Innovation governance

Due to the crucial role of innovation in the modern economy, most countries have put in place explicit innovation policies. Innovation policies are becoming a point of convergence between industrial policy and science- and technology policy, containing elements of both, but at the same time opening up new perspectives and avenues of policy. Given the importance of industrial- and social innovation for competitiveness and other policy areas in a country, the question is whether the present system (or indeed what kind of system), of public governance concerning science, technology and innovation would be adequate for the advancement of innovation and whether the increasing costs and the necessary coordination between public policy areas are best served by the present institutional set-up.

The European Commission has defined five objectives for innovation policymaking:[20]

- Coherence of innovation policies;
- A regulatory framework conducive to innovation;
- Encourage the creation and growth of innovative enterprises;

[20] Communication on 'Innovation in a knowledge-driven economy' COM (2000) 567 of the European Commission.

- Improving key interfaces in the innovation system; and
- A society open to innovation.

One of the main challenges for policymaking is coordination; as from the above five objectives it can be derived that, traditionally, these are being covered by different ministries. Inter-functional problems, such as innovation, call for inter-functional solutions. Innovation policy however, ought to be considered as 'horizontal policy' thereby requiring co-ordination of the policies of the individual government departments concerned.

The OECD defines governance of innovation as a normative, multi-actor and multi-level perspective on the management of the innovation system that accommodates the dynamics of innovation.[21] The European Commission's definition of governance is: "Governance' means rules, processes and behaviour that affect the way in which powers are exercised, particularly as regards openness, participation, accountability, effectiveness and coherence".[22] Governance of innovation defines the roles that various actors play in the innovation system, how the rules of the game work, how decisions are taken and how changes in the overall innovation system come into being.[23]

Innovation governance mechanisms vary from country to country. There may be high-level bodies providing strategic frameworks, single ministry or governmental bodies assigned with the coordination role or decentralized decision-making assigned to many ministries/departments depending on their scope and scale of responsibility and control. In any case two major efforts need to be made in order to establish an effective working coordination of innovation at national level. These are:

- Avoidance of a sector-driven approach in decision-making for innovation, which in some cases can be achieved by introducing another layer in the policymaking, overarching the level of the individual ministries/departments; and
- Development of a national innovation strategy that in many cases leads to a national consensus and a clear allocation of roles and responsibilities towards achieving the strategic goals.

The assessment of the national innovation system and innovation governance in Belarus is presented in the context of the definitions outlined in this section.

2.2 Assessment of the National Innovation System of Belarus

The assessment of the national innovation system of Belarus follows the logic of the base model introduced in section 2.1. It starts with the environment for innovation as it provides the overall framework for any innovation system to emerge and develop. Next, special

[21] OECD (2005), Governance of innovation systems: Volume 2: Case studies in innovation policies, Paris, OECD.
[22] EC (2001), COM 428 final, Brussels.
[23] P. Boekholt (2004), Ensuring policy coherence by improving the governance of innovation policy, Trend Chart Policy Workshop, Brussels, 27-28 April 2004, p.5.

attention is drawn to these subsystems of the country's NIS that could be further developed in order to achieve improvements in the functioning of the NIS.

Environment conducive to innovation

Already in the early 1990s, Belarus openly declared its strategic policy objective to develop an economy based on science and technology.[24] Since then, more than 25 Laws and Presidential decrees have been introduced, some 40 governmental decrees have been issued and many other legal acts have been put in place to contribute to this stated aim. All this has created an effect of broad awareness and recognition of the importance of science and technology for the economic prosperity of the country.

In 2007, with the approval of the State Programme for Innovative Development (SPID), the main emphasis was placed on innovation resulting from the commercialization of scientific outputs. This programme has introduced the concept of the national innovation system and governance. Subsequently, substantial efforts were made to organize the institutional element of the national innovation system. The roles of the different levels of government as well as of different governmental institutions at the national and regional levels have been defined.

The strategic goal of the State Programme for Innovative Development is an innovative, competitive, science-based, sustainable and socially oriented economy of Belarus. One of the main tasks of the Programme is actually to define the national innovation system and its functioning. The innovation system of Belarus is seen as a combination of:

- Laws and regulations;
- National strategic priorities and their translation into programmes at all levels;
- Sources of financing and human resources; and
- Allocation of responsibilities at national, regional, local as well as the institutional level for the management, organization and control of the programmes.

The Concept of the national innovation system has been developed on the basis of the National Strategy 2020; the Technology forecast 2006-2025 and other strategic documents of ministries and other governmental bodies. The Science and Technological Policy Committee of the Council of Ministers approved the Concept on 8 June 2006.[25] The Concept recognises the sectoral approach as predominant in developing and implementing the science and innovation policy in the country. The Concept rightly points out some of the weak points in the existing NIS, in particular, the entrepreneurial sector, which still does not adequately perform the role of being one of the main catalysts for development of the innovation infrastructure and market.

[24] Law on state science and technology policy of 1993.
[25] Publication of the State Committee for Science and Technology, Minsk 2006.

The design of innovation policy

The whole set of innovation-related legal and regulatory acts puts the main emphasis on science-based technological innovation. This type of innovation activity is not only assigned the highest policy priority in Belarus but as a matter of fact seems to be taken as synonymous to innovation in the broad sense. Compared to the current, prevailing understanding of the notion of innovation (see section 2.1), this appears as a somewhat narrow interpretation. In this sense, the prevailing understanding of innovation in Belarus may not always treat some products, services, organizational and managerial changes, etc., as innovations, although they would count as such in accordance with the internationally-agreed understanding of innovation. This situation emerges in practice despite the fact that a wider definition of innovation has been recognized early in legal texts.[26]

From this perspective, the actual coverage of the policy measures that fall into the domain of "innovation policy" in Belarus is probably also narrower in scope and coverage than corresponding measures in other countries which adhere to a broader conceptual interpretation of innovation.

The State Programme for Innovative Development offers a top-down allocation of tasks and responsibilities that are to be realized through state programmes. The design and adoption of the Programme is the result of a lengthy planning and coordination process (see box 2). State programmes are integrated in a hierarchical structure, as illustrated in figure 5, which presents the relations between the various types of programmes.

Box 2. The State Programme for Innovative Development of the Republic of Belarus: How is it put in place?

The "State Programme for Innovative Development of the Republic of Belarus" (SPID) is the outcome of a complex process of planning and coordination, and forms the main framework for state programmes and projects during the programming period. This programme is an aggregation of programmes and projects put forward by the stakeholders or resulting from the application of broad priorities.

The fundamental decisions concerning the course and financing of innovative activities are taken during the process of programme design.[i] The State Committee on Science and Technology plays a pivotal role at this stage. The Committee carries out the scientific and technical review of the programmes and projects and thus coordinates and consolidates the plans and intentions of ministries, state committees, other government bodies and the Academy of Sciences that use budget funding for R&D and innovation at the national level. This process also encompasses regional development strategies and sectoral strategies developed by local authorities/municipalities, ministries and concerns (sectoral conglomerates, typically with a significant public ownership share). The programmes at the various layers of governance must contribute to the achievement of the national priorities as laid down, for example, in the Presidential Decree No. 315 on Scientific and Technological Priorities (6 July 2005). The outcome of this process is eventually approved by the Council of Ministers.[ii]

[26] For example, in the Law on Scientific-Technical Activities adopted in January 1993.

Box 2. The State Programme for Innovative Development of the Republic of Belarus: How is it put in place? *(continued)*

The programme contains detailed target figures in the form of indicators. These include the number of (domestic and foreign) technologies to be introduced and the share of turnover that is based on innovative products, both of which are important innovation output targets in this context.[iii] As the activities in the state controlled organizations are the main sources of innovation, the authorities can directly influence the outcome of these indicators. In contrast to most other countries, where such indicators are ex-post measures of the "success" of innovation support activities, the Belarusian system allows for the use of these indicators for the purpose of management and direction of companies under state control. This is also reflected in the project-based planning process that contains a consistent set of indicators (i.e., in line with the target indicators of the state programme). The outcomes of these planning processes are lists of projects to be implemented in the planning period, with an indication of the envisaged financial resources.[iv]

The projects fall into three categories: 1) Creation of new enterprises and top-priority productions, 2) Creation of new productions at operating enterprises, and 3) Modernization of existing productions based on the introduction of new (high) technologies. This categorization of projects suggests that a substantial part of these efforts are investments or incremental innovation.

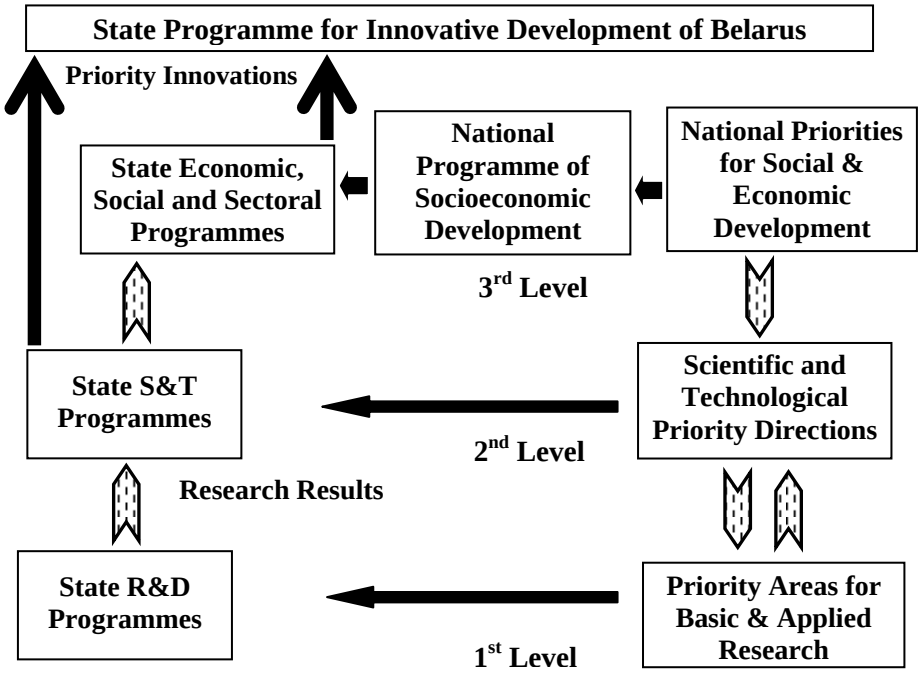
The content of the SPID is analyzed in more detail in chapter 3.

[i] For an overview see http://www.government.by/public/shared/rus/innovations_p/en/01.html
[ii] An overview of this process can be found at:
http://www.government.by/public/shared/rus/innovations_p/en/02-1.html.
[iii] For a complete list of target indicators see: http://gknt.org.by/rus/gpir/pokazatelspis/.
[iv] See http://gknt.org.by/rus//gpir/gpirpass/ or
http://www.government.by/public/shared/rus/innovations_p/index_en.html or the concept for the 2010 to 2015 period: http://gknt.org.by/rus//gpir/gpir2011-2015/

Figure 5 illustrates the hierarchical structure of the state programmes, and how they relate to the State Programme for Innovative Development. The first level corresponds to the State Programmes of Scientific Research, which concern both fundamental and applied research. These programmes are created to develop the priorities for scientific research defined by the government. The Academy of Sciences has the role of organizing and coordinating the implementation of these programmes. There are 40 of these programmes and there will be 16 in the next five year period (2011-2015).

The second level corresponds to the State Science and Technology Programmes, which are based on the priorities for scientific development approved by Presidential decree. The implementation of these programmes is coordinated by the State Committee on Science and Technology.

Figure 5. Hierarchical structure of State programmes



Source: Presentation by I. Solonovich at the fifth session of the UNECE Committee on Economic Cooperation and Integration, 1-3 December 2010, Geneva.

The two levels of programmes are grouped according to the priority directions of scientific-technical activity in the so-called "State Complex Target Scientific and Technical Programmes". This integration seeks a better coordination between scientific research and the use of its results for further technical development. In 2010, there were 11 complex programmes,[27] which included 33 state programmes of scientific research and 27 state scientific-technical programmes. For 2011-2015, a total of 12 complex programmes are envisaged, including 18 first level programmes and 28 second level programmes.

The third level includes state programmes on economic or social affairs and those with a specific sectoral focus, which are approved by the President or the Government. They serve to implement the priorities for the development of the country contained in the National Programme for the Socio-economic Development of Belarus.

Financing mechanisms differ. Budget support is around 85% for the programmes of first level and only 50% for the programmes of second level. For the programmes of third level, state financing may cover fully all the costs or rely completely on other sources of financing, depending on the area of activity. The programmes of first and second level that are more important for innovation are grouped in the State Programme for Innovative Development.

[27] These programmes target the following areas: rural development, biotechnologies and bio-safety, materials, mechanical engineering, energy, chemical products and technologies, information technology, technology in disaster situations, electronics and optics, health and environment.

Financing is provided in accordance with the original provisions of the programmes that are included in the SPID.

As a result of this aggregation process, the State Programme for Innovative Development offers a very detailed list of actions and indicators per ministry, per region and per "state concern"[28] as well as the needs for financing that are defined in relation to the source of financing (e.g. state or local budget, bank credits, loans and own resources, see box 6 for more details on financing arrangements).

Coordination and governance

The coordination of the State Programme for Innovative Development (SPID) is assigned to the State Committee on Science and Technology (SCST). The SCST, with the support of the Belarusian Institute of Systems Analysis (BelISA), is also tasked with the monitoring and reporting to the Council of Ministers on the realization of the Programme.[29] Taking into account the numerous subprogrammes of the State Programme for Innovative Development and the stakeholders involved, the responsibilities of the SCST are rather complex.

It is important to pay attention to the mechanism of how the subprogrammes are elaborated. Although the SPID is introduced top down (e.g. with a Presidential decree and a Decree of the Council of Ministers), the process involves suggestions from all stakeholders, in this case ministries, regional authorities and state concerns. Ministries and regional authorities may collect suggestions from their sub-structures. At the same time, the priorities for the state complex programmes are defined at the national level. Finally, the national priorities and the bottom up suggestions are brought together in the SPID. This coordination process is in principle logical, articulating various programmes in a single document that reflects priorities in different areas.

At the same time, taking into consideration the nature of the stakeholders who are providing the input for the Programme, one can notice that:

- Scientific research (both basic and applied) is carried out primarily (more than 90% and 70%, respectively) at the National Academy of Sciences, and to a lesser extent in the R&D structures of the Ministry of Education and the Ministry of Health. The development is carried out at the R&D structures of the Ministry of Industry; and
- The stakeholders mainly represent the state sector and large industrial enterprises;
- The sectoral line of coordination is strong.

In terms of governance, the evidence discussed above clearly shows that innovation attracts considerable attention and is assigned a high policy priority in Belarus. In fact, this is a very positive development as there are countries, including members of the EU, who still struggle with putting innovation near the top of their political agenda. The coordination of the State

[28] There are five state concerns/ organizations: Belbiofarm, Belgospisheprom, Bellegprom,Bellesbumprom, Belneftekhim.
[29] Presidential Decree No. 136 of 2007.

Programme for Innovative Development is also clearly assigned to one body, and this is the SCST.

At the same time, the sectoral predominance of the orientation of the Programme and its stakeholders defines the departmental character of the decision-making process as well as vertical information flows. As we mentioned earlier, innovation in the modern economy requires a more horizontal approach. The horizontal approach also reflects the understanding of the NIS as a network of different actors whose interactions (links) are important for the innovation system to be effective. The subsystems of the NIS are also influencing each other, encouraging their development. In this line of discussion, the following section turns to the state of affairs of the main subsystems of the NIS of Belarus as well as to some of the links that show current weaknesses.

Policy implementation

Funding for the SPID is part of the budget process which is under the responsibility of the Ministry of Finance. The annual state budget contains the actual budget allocations for the financing of innovation projects by the various line ministries. However, the actual selection of projects to be financed (including those that fall under the responsibility of different ministries), constitutes part of the responsibilities of the SCST.

Once the SPID priorities and its funding are approved, R&D institutions as well as industrial companies can make bids for innovation projects that fall under the coverage of the approved subprogrammes. There are both competition elements and project screening in the process of programme implementation. On the one hand, there may be competing bids in the same programmatic area. On the other hand, the project bids are subject to several stages of peer review aimed at securing the required quality standard of the bids. This in some cases results in the rejection of bids. The work of the public bodies engaged in the screening process is coordinated by the SCST and the latter is ultimately responsible for the selection of the winning innovation project bids, which are allocated funding under the SPID. Only projects that pass successfully all the stages of this competitive screening process are entitled to funding from the SPID, according to the provision of the corresponding subprogramme.

The constellation of innovation stakeholders described above, in particular the dominance of sectoral coordination, presents some challenges for the development of the entrepreneurial sector for innovation and does not always encourage the development of stronger links between science and industry. Moreover, the existing policy mechanisms can only address to a limited extent these very important aspects of the innovation system, which are essential for its efficient functioning. In addition, this constellation of stakeholders and the allocation of resources by institutions (rather than on the basis of addressing the main challenges for innovation) does not sufficiently encourage horizontal cooperation among key stakeholders, namely, cooperation between different ministries or governmental departments.

In the attempt to ensure a high degree of detail, the State Programme for Innovative Development represents a rather complicated framework of subprogrammes and measures at different levels which creates a challenge with respect to management, monitoring and evaluation. The subprogrammes can be perceived more as a set of individual measures rather

than a policy mix (inter-related measures that reinforce each other), addressing cross-ministerial and/or cross-sectoral issues, despite the hierarchical approach that informs their aggregation into the SPID. Such issues are, for instance, the growth of small innovative companies or support to establishing small companies as spin-offs from R&D institutions.

Another cross-departmental area which is not directly targeted by the SPID is the development of an entrepreneurial spirit among the young people of Belarus, starting with secondary education but especially in the technical and technological universities. According to some studies, becoming an entrepreneur is not among the career objectives of most young people in Belarus. Although this issue may appear as a challenge for the education system proper, in many countries it is addressed in a horizontal manner, with the close involvement of the business sector and mobilization of private funds. However, it must be noted that the effectiveness of efforts to encourage entrepreneurship depends on the existence of a friendly business climate (see chapter 3).

The subsystem of science

Similarly to neighbouring Russia and Ukraine, Belarus has a substantial R&D potential, 80% of which is concentrated in the National Academy of Sciences and the R&D structures of the Ministry of Industry, Ministry of Health and Ministry of Education. Fundamental research is carried out primarily by the National Academy of Sciences. Units under the Ministry of Industry undertake most of the development and implementation routines.

The economic realities following the break up of the former Soviet Union have made many of the previous R&D-industry links obsolete or not applicable. The technical and technological base of the industry, which had been developed for decades to serve a larger market, was difficult to maintain in view of the size of the economy and its changing trade partnership structure.

Although the R&D potential in terms of human resources remains high, its deteriorating age structure, as well as brain drain, has negatively affected actual performance. During the last ten years, the share of R&D staff between 30 and 39 years old has halved (from above 30% to about 15% of total). The number of those aged 60 and above has grown six fold. The reputation of scientists and their status in the country remains high but the appeal of the profession has declined. The average value of R&D equipment per R&D staff member is around $80, a value which is a fraction of that in developed countries.

The business enterprise subsystem

The industrial and export structure of Belarus, in particular, its dependence on a small number of large industrial producers is a source of potential vulnerability. Thus, potential external shocks in specific industries may have significant economic effects, with negative consequences such as increased unemployment. This structure is also a source of regional disparities, with a detrimental effect on economic growth. In addition, the introduction of innovation in large industrial enterprises would require investments on a scale that the country may be unable to manage. Hence, the present industrial structure of Belarus appears to be vulnerable to market changes and less flexible for innovation.

As noted in section 2.1, entrepreneurship plays an essential role in innovation activities. From this perspective, the recent trend of a rising number of small companies in Belarus (e.g. their number grew by 10.7% in 2009 compared to 2008),[30] is a positive development. At the same time, the contribution of the small business sector to GDP was at a rather low level - 11.4% in 2009. The distribution of SMEs by sectors has remained very much the same over the years 2007-2009: more than 40% of SMEs are in the sector "trade and restaurants," and about 20% are in the manufacturing industry. The share of SMEs in the sectors "transport" and "communication" is about 20%. Most of the SMEs are private companies; 2% of all SMEs are in state ownership and 2.5% are those with foreign participation.[31] The share of SMEs in national employment is low and has not changed much in recent years. More than 60% of all small companies are located in Minsk and the Minsk region, while the share of small companies in the other five regions is 7.5%, on average.[32]

The overall picture of innovation activity in Belarusian SMEs is somewhat bleak. The number of innovative companies was about 600 in 1997, and decreased in the years that followed. In 2006, the number of innovative enterprises was 318 and this has been taken as a starting point for the State Programme for Innovative Development, which sought to increase the number of innovative firms to 581 by 2010. However, the number of innovative SMEs is about 280 at present. These enterprises employ only about 0.6% of total company employees.[33] Probably due to the low representation of small innovative companies in the country's economy, the National Statistical Committee has not produced special reports on the innovative activities of SMEs in recent years.

As far as small spin-off companies from R&D and/or academic institutions are concerned, there are no specific and detailed statistics at present. According to anecdotal evidence, such companies do exist and they are mainly concentrated in such structures as science or high-tech and technoparks, stand-alone structures or attached to universities. However, the number of spin-off companies is very limited.

The above snapshots of the two subsystems of the national innovation system, namely, those of science and business, lead to the following main conclusions:

- There is a high R&D potential in Belarus, which serves mainly traditional sectors of the economy concentrated in a number of large companies. These companies represent the core of the Belarusian economy and exports;
- The dominance of large companies in the Belarusian economy and the R&D potential associated with them makes the national innovation system highly dependent on a relatively small number of industries and export lines as well as on a limited number of enterprises;

[30] N. Badey, Small business in the Republic of Belarus, in: Statistics of Belarus Journal, No. 3, 2010, Minsk, pp. 26-34.
[31] Figures are for 2009 and are at the same level or lightly lower than the figures for 2008.
[32] Brest, Vitebsk, Gomel, Mogilev, Grodnen.
[33] There are two types of SMEs in Belarus: micro-enterprises with less than 15 employees and small enterprises with less than 100 employees.

- The market-demand role in the innovation system, which is to "pull" innovations, is limited to the domestic market and the traditional markets of the former Soviet Union, with a slight increase of the EU market's share, mainly for petrochemical products. Thus the market pull for innovation can be considered to be somewhat weak; and
- The R&D-pushed innovations may have a higher chance of materializing due to the substantial R&D potential especially in science disciplines such as physics, mathematics, chemistry, etc. Trends such as aging, brain-drain, limited high-tech R&D equipment as well as the somewhat limited exposure of Belarus scientists to world science and technology achievements, need to be looked at seriously as they may erode the foundations of Belarus' own R&D.

The innovation infrastructure: the subsystem of intermediaries

The subsystem of intermediaries or the innovation infrastructure as it is referred to in Belarus, is considered in a number of legal documents such as:

- Law on national science and technology policy;[34]
- Law on state support to small enterprises;[35]
- Presidential Decree on high-tech parks;[36]
- Presidential Decree on the establishment of applied science centres at the National Academy of Sciences;[37]
- Presidential Decree on State Programme for Innovative Development of the Republic of Belarus for 2007-2010;[38]
- Presidential decree on procedures for the establishment of innovation infrastructure;[39]
- Presidential Decree on taxation of high-tech organizations;[40]
- Presidential Decree on stimuli for innovation activities.[41]

The policy push towards establishing innovation infrastructure in the country has been emphasized in the Presidential decree of 2007 and reinforced by the State Programme for Innovative Development for 2007-2010. The State Programme for Innovative Development explicitly targets the growth of the number of these institutions. It has added the goal to establish three venture capital organizations. It has also foreseen an increase in technoparks, business incubators, innovation centres and marketing and information centres (see chapter 3 for more details).

There are more than 80 different institutions that belong to the innovation infrastructure of Belarus. They provide consultancy, information and organizational support to innovation activities. At the same time, not all of the targets listed in the State Programme for Innovative

[34] No. 2105-XII from 19 January 1993.
[35] No. 685-XIII from 16 October 1996.
[36] No. 12 from 22 September 2005.
[37] No. 242 from 18 April 2006.
[38] No. 136 from 26 March 2007.
[39] No. 1 from 3 January 2007.
[40] No. 662 from 4 December 2008.
[41] No. 123 from 9 March 2009.

Development for 2010 are being fully achieved. For instance, the number of science and technology parks at present is nine. Only three of them have officially received the status of science and technology parks.[42] These are: Technopark "Metolit" at the Minsk Technical University, Minsk Regional Innovation Centre and Brest Centre for Science and Technology.[43] It is estimated that all nine parks are contributing about 1% of the volume of innovative production in the Belarus economy.[44]

Technoparks usually integrate a number of different intermediaries. The Technopark Mogilev, for instance, has a centre for information and consultancy, an incubator for small companies, a business innovation centre, technology transfer centre and a specialized information centre in the field of energy efficiency. It has 23 resident companies; it has an annual turnover of some 10 billion Belarusian roubles and has contributed some 2.5 billion Belarusian roubles to the national budget.[45] Technopark Metolit in Minsk has a similar profile, with an additional marketing support centre. It has 13 resident companies, a turnover of 11.2 billion Belarusian roubles and a 2.8 billion Belarusian roubles contribution to the national budget.

An interesting initiative is the information-marketing network of the Ministry of Education, which aims at providing matchmaking opportunities for companies to place requests for R&D to universities, and universities to place offers to solve technological and other problems for industry. In addition to technoparks and the marketing network, there are two innovation centres, 11 transfer centres, three centres for international technology transfer and some others.

The National Academy of Sciences has created its own network of intermediaries. It has established an innovation association called Akademtechnopark with 20 members; an innovation centre under the Institute of Metal Techologies in Mogilev; and 32 other science and technology and entrepreneurial structures. The Republican Technology Transfer Centre has been established within the structure of the Academy with five regional units and 15 branches attached to other institutions and organizations. The majority, if not all institutions of the innovation infrastructure of Belarus, have been established under the initiative of the public sector.

It is important to mention that innovation intermediaries and support institutions such as the technoparks or similar organizations within the Academy of Sciences or the universities facilitate not only the performance of small innovative companies, but also establish a higher degree of protection for them. Although the number of such institutions is not substantial for the R&D capacity of Belarus, their current experience is positive. Therefore, potential exists to increase the role of innovation support institutions such as the technoparks in creating and developing small innovative enterprises.

At the same time, the available evidence suggests that very few technopark-supported companies (if any at all), have left the technoparks so far. Such an outcome could suggest that

[42] Juridical status in accordance with Decree No. 1 from 2007.
[43] The status of a technopark is awarded by the State Committee of Science and Technology.
[44] Quotation from Science and technopark "Metolit".
[45] Figures in this paragraph are for 2009.

the business environment outside the technoparks is not sufficiently conducive to innovative companies, and perhaps to small and especially private companies. It could also indicate that innovative companies within the technoparks are more R&D-"pushed", rather than market "pulled". Finally, it could also mean that when approaching a possible growth phase, innovative companies are unable to secure the resources to grow, and therefore stay small and in the protective environment of the parks.

The regional dimension of the national innovation system

Table 15 shows a significant concentration of innovation infrastructure in the city of Minsk compared to other regions. This picture is related to the general regional disparities between Belarusian regions that deepened during the reform period of the mid-1990s until present, in contrast to the Soviet period when regions were more similar in economic structure. Significant variations in incomes, poverty, health and educational attainment exist between areas of relative prosperity and a large number of depressed regions, particularly in small towns with a weak industrial base and rural communities formed around poorly performing agricultural farms. In these regions, there is a high prevalence of low-paying job opportunities and rapid out-migration of young and better-educated people.

Table 15. The innovation infrastructure of Belarus, by region

	Brest oblast	**Vitebsk oblast**	**Gomel oblast**	**Grodno oblast**	**City of Minsk**	**Minsk oblast**	**Mogilev oblast**
Industrial companies	324	329	348	295	275	432	268
of which, innovation-active companies	53	31	42	40	74	53	25
Scientific-production centres	3	2	6	3	33	6	3
Research organizations	16	25	28	15	181	15	15
of which institutions of higher education	4	5	7	5	30	–	4
The High-Technology Park	–	–	–	–	1	–	–
S&T parks	1	1	1	1	5	–	1
Innovation centres	1	–	1	–	1	1	1
Technology transfer centres	2	3	6	2	8	1	2
	Brest oblast	**Vitebsk oblast**	**Gomel oblast**	**Grodno oblast**	**City of Minsk**	**Minsk oblast**	**Mogilev oblast**
Business-incubators	1	1	2	–	2	1	2
Information and marketing centres	1	1	2	1	3	–	2
S&T libraries (including factory libraries)	44	47	77	43	175	50	40

Source: http://www.government.by/public/shared/rus/innovations_p/en/05.html

Regional innovation infrastructure centres (see box 3) have great potential to correct regional disparities and to promote a more balanced regional economic growth, from a bottom-up perspective that is complementary to the prevailing top-down approach of the current policymaking framework. Regional S&T programmes, which are an important policy instrument to realize this potential, are currently under-exploited (see chapter 3).

Box 3. The regional innovation infrastructure of Belarus

Some of the most important innovative centres in the regions include:

Brest region: The Brest regional municipal 'Centre for the introduction of scientific and technological developments' (BOKUP TSVNTR), is the coordinator of all innovation infrastructure elements. The centre coordinates innovative projects that support the regional S&T programme of the Brest region, business planning and consulting services to the region, conferences, training programmes, etc.

Vitebsk region: The Polotsk State University industrial park (supported by two projects under the State Programme for Innovative Development of the Republic of Belarus for 2007-2010), a branch office of the National Technology Transfer Centre, the consultancy company 'Vitebsk Marketing Centre' founded by the Ministry of Foreign Affairs of the Republic of Belarus, which organizes the annual regional investment forums.

Gomel region: A business incubator of the National Technology Transfer Centre, a branch office of the Belarusian Innovation Fund, the Free Economic Zone "Gomel-Raton", Technopark.

Grodno region: The Technology park of the Grodno State University, a business incubator and several agro-technoparks that are now in construction with funds from UNIDO, a branch office of the National Technology Transfer Centre, an office of the Belarusian Innovation Fund.

Mogilev region: The Joint Stock Company Mogilev Technological Park, which acts as a small business incubator. The region also hosts a branch office of the National Technology Transfer Centre and of the Belarusian Innovation Fund.

The city of Minsk: It hosts the National Academy of Sciences of Belarus, most of the leading universities, industrial research institutes, high-tech enterprises, 5 S&T parks (including the only private industrial park "Arvit"), as well as the High-Technology Park - an IT-specialized area, created in 2005.

Although there are a variety of innovation intermediaries, their number is insufficient and, what is yet more important, their aggregate impact is not substantial. What is especially lagging behind is the part of the innovation infrastructure responsible for the financing of innovation (see chapter 6 for more details). The participation of the business sector, in particular of large enterprises, in the development of the innovation infrastructure is fairly limited. For a comparison, in many EU countries industry matches the public funding in establishing innovation infrastructure, which serves to stimulate the links between science and business. This motivates the business to utilize the available R&D potential and gives

opportunities to R&D institutions to come closer to and get to know the needs of the business (see chapter 5).

The above snapshot of the innovation infrastructure as one of the most important subsystems of the national innovation system, leads to the following main conclusions:

- There is a wide recognition in the country that innovation infrastructure is important for innovation activities. As a result of a number of normative acts, more than 80 intermediaries of different kinds have been established in the country with concentration in Minsk but also with significant presence in certain other regions (e.g. Mogilev).
- Apart from the question of whether the number is sufficient for Belarus, there is the issue of the efficiency of these intermediaries: how much they contribute to the growth of innovation activities, transfer of technologies and linking science and business. This issue needs to be reviewed and analyzed critically prior to introducing new forms of intermediaries.
- Most of the innovation infrastructure has been established at the initiative of public institutions, including ministries (e.g. the marketing network of the Ministry of Education). The contribution of the industry and private funding in creating and developing the innovation infrastructure is almost completely missing.
- The innovation intermediaries that have been set up in Belarus are mostly of consultative, informative and matchmaking types. Intermediaries involved in providing financial means for setting up innovative companies and especially supporting them in the growth stage are fairly limited in number and scope of activity. This may be one of the reasons why spin-off companies from universities do not grow fast enough and why there are few innovation start-ups.

2.3 Recommendations

The prevailing understanding of the notion of innovation in Belarus, which is also embodied in the policy domain, puts the main emphasis on science-based technological innovation. The internationally agreed understanding of innovation is much broader in scope and distinguishes between four types of innovation: product innovation; process innovation; marketing innovation and organizational innovation. From this perspective, the actual coverage of the policy measures that fall into the domain of "innovation policy" in Belarus are probably also narrower in scope and coverage than the corresponding measures in other countries which adhere to a broader interpretation of the notion of innovation. A truncated innovation policy may lead to inefficiencies in the performance of the national innovation system.

Recommendation 2.1

Broaden the scope of policy measures and instruments that fall into the domain "innovation policy," with a view to aligning the national with the international coverage of innovation policy and raising the efficiency of the policy mix:

- *Undertake a critical assessment of the innovation policy mix in Belarus with a view to comparing its coverage with that in other countries and identifying mismatches;*
- *Based on this assessment, plan steps for broadening the scope of policy measures and instruments that fall into the domain "innovation policy" (some policy measures of this type are contained in further recommendations); and*
- *Undertake an awareness-raising campaign related to the above changes, targeting in the first place policymakers with responsibility for innovation policy, but also all policymakers and the general public.*

There is a broad awareness and recognition of the importance of innovation for the future growth and competitiveness of Belarus by the authorities. As a result, substantial efforts have been made to organize the institutional element of the national innovation system (NIS). There have also been important steps to create essential elements of the innovation infrastructure. However, the focus has been largely placed on the administrative (institutional) element of the NIS rather than on the links and interactions between different subsystems (e.g. business, science, education, infrastructure, etc.).

Recommendation 2.2

Further efforts are needed towards identifying weak or missing links between stakeholders in the NIS and addressing these gaps through strategic measures. Initiatives in this area could:

- *Target a shift from a "linear innovation model" to a fully interconnected multi-linkage NIS;*
- *Ensure interconnectedness along the entire innovation process, so as to avoid any gaps; and*
- *Follow a gradual approach, focusing initially on improvements that are more likely to have a positive impact in the short-term, thus creating space for further interventions.*

The present NIS and innovation governance are mostly oriented towards sectors and industries (the so-called vertical approach). This has been a good departing point but the system at present is very dense with institutions and programmes and, consequently, quite cumbersome. Even more importantly, such an approach fails to establish efficient horizontal interactions (e.g. multi-disciplinary, cross-sectoral and cross-departmental interactions), which are essential in a modern NIS.

Recommendation 2.3

Design and put in place measures to establish and strengthen the currently missing horizontal strategic approach to address innovation policy issues. To contribute to this goal, the authorities could:

- *Emphasize the horizontal policy approach in strategy documents and other high-level policy formulations;*

- *Complement existing "vertical" instruments with "horizontal" ones, cutting across firms, industries and sectors and contributing to the establishing of linkages and better connectivity among innovation stakeholders; and*
- *Establish a corresponding institutional structure (e.g., a National Innovation Council) with the participation of all key innovation stakeholders (from the public sector, the business sector including SMEs, R&D and academic institutions, etc.) and targeting strategic horizontal challenges in the entire NIS and the interrelation between stakeholders and institutions. The State Committee on Science and Technology could serve as Secretariat to the Council.*

The analysis of the national innovation system of Belarus indicates that the entrepreneurial sector is one of its weaker parts. A fast growing small and medium enterprises (SME) sector, in particular innovative, high-risk enterprises, is needed to ensure sustainable and vibrant economic growth. SMEs provide important complementarities to the innovative activities of large firms. Existing R&D and academic institutions, as well as large enterprises, can be a source for the emergence of innovative spin-off SMEs.

Recommendation 2.4

Widen and broaden the range of measures to stimulate the development of the entrepreneurial sector. Practical steps could include the following:

- *Undertake a detailed, critical assessment of existing barriers to the emergence and growth of SMEs;*
- *On this basis design targeted policy measures in consultations with SMEs and entrepreneurs;*
- *Put in place measures enhancing the potential of R&D and academic institutions as well as large enterprises to become sources of innovative entrepreneurship, including the encouragement of spin-offs in the form of small companies.*

The emergence of a vibrant entrepreneurial sector and the commitment to innovation requires not only administrative support and economic incentives but also a cultural shift in the attitudes of the population. The strong support received by innovation at the highest policy level is a good start to communicate these priorities in a powerful way to a wider population.

Recommendation 2.5

The authorities could consider public awareness programmes targeting innovation stakeholders and the wider public and stressing the importance of innovation entrepreneurship:

- *Special emphasis could be assigned to appreciation and support for those who take risks, in particular, small innovative companies;*
- *Programme would stimulate a new attitude regarding entrepreneurship and innovation, especially among young people; and*

- *A variety of means that could be used for such purpose, including national awards, national competitions, TV shows, education in entrepreneurship in secondary and higher education institutions or informal innovation platforms.*

Chapter 3

FRAMEWORK CONDITIONS, INNOVATION POLICIES AND INSTRUMENTS

This chapter considers the institutions and conditions that support innovation and the active role of the government in the innovation process within this context. Section 3.1 describes key elements that influence the national innovation capacity, including relevant aspects of the general business environment. Section 3.2 describes and analyzes the current state-funded S&T programmes, highlighting specific features in their implementation that have worked successfully or require further improvements for optimal effectiveness. Section 3.3 provides an overall assessment and recommendations, as well as a general evaluation of these policy initiatives. This evaluation is in terms of the relevance, comprehensiveness and feasibility of policy initiatives towards the goals defined, in particular in view of the existing framework conditions, and forms the basis for a set of policy recommendations.

3.1 Framework conditions for innovation and support instruments

The general business environment

The innovation support system should be considered in the context of the general business environment in the country. In this context, the World Bank's 2009 Enterprise Survey for Belarus[46] highlights several key features of the country's business environment, such as:

- Belarus' leading position among Eastern European and Central Asian (ECA) countries in terms of government/state participation in private firms (with mixed ownership) - 10% on average. While private SMEs typically have state participation in the range of 6-9%, state participation in large firms may be significantly higher.
- Second position (after Russia), in terms of average firm size: the country has very large firms (on average 91 permanent full-time workers), which is more than twice the ECA average. Nevertheless, over 40% of retail and other services firms have less than ten employees.
- Third position among ECA countries (after Moldova and the Kyrgyz Republic), in terms of female participation in business ownership (49% of female ownership on average).
- Less reliance on bank financing for purchases of fixed assets.
- Higher degree of integration in international trade in comparison with most ECA countries (26% of firms export, 73% of manufacturing firms use foreign inputs). Firms with government participation use significantly more domestic inputs than fully private firms. Firms in and around Minsk are less likely to use foreign inputs than in any other region: 22% in and around Minsk compared to a national average of 73%.

[46] World Bank (2009), Enterprise Surveys. Country Note Series Belarus. Available at: http://www.enterprisesurveys.org/documents/CountryNotes/Belarus_09.pdf

Another important component of the business environment is the competition legislation that is in place. The basis of competition law in Belarus is the law "On counteracting monopolistic activity and competition development"[47] that defines the institutional and legal framework for the prevention, control and suppression of monopolistic activity and unfair competition with a view to ensuring an effective functioning of markets, promotion of fair competition, and protection of the rights and legitimate interests of consumers. This Law was followed by several changes in the legal framework of anti-monopoly control and regulation, which initiated a process of de-monopolization of the economy, and the formation of competitive markets. However, the de-monopolization process remains at a very early stage.

The potential of an economy to attract investment, in particular FDI, is closely linked to the characteristics of its business environment. Relatively low levels of FDI (see chapter 1) suggest that there are some shortcomings that need to be addressed. However, FDI is receiving an increased policy attention (see box 4), which is likely to spur further reforms to improve the framework for investment and economic activity in general in the country.

Box 4. Business environment and FDI

The recent *Investment Policy Review of the Republic of Belarus*[i] identified a number of actions that would make Belarus more attractive as an investment location and help secure development gains from FDI for the domestic economy.

Key actions to be taken in this respect include:

- Fostering a sustainable and dynamic local private sector for increasing local business opportunities and enabling Belarus to take advantage of incoming investment (a fair pricing mechanism, an effective land titling system, a competitive fiscal regime and non-discrimination in the access to raw materials and industrial inputs).
- Adoption of an FDI strategy based on further improvements to the investment climate in areas such as fiscal competitiveness, competition policy and administrative efficiency.
- Adoption of a strategy to support the development of SMEs through FDI. More specifically, this includes strengthening the treatment and protection provisions of the investment code, removing obstacles to SME development, particularly in the areas of price regulations, reporting requirements and administrative controls; and adopting targeted policy interventions to foster the developmental role of FDI for the SME sector, such as carrying out professional investor targeting activities to attract investors in sectors which are prone to the establishment of supplier linkages and designing specific linkages policies (see chapter 4).

[1] UNCTAD (2009), Investment Policy Review of the Republic of Belarus, New York and Geneva.

[47] Law No. 2034-XII of 10 December 1992 and amendments.

The innovation support system should also be seen within the overall system of state support in Belarus. Its extensive system of state subsidies amounted to 8.6% of GDP in 2009 (without net export oil subsidy). A World Bank study[48] notes that since 2004, the Government has made the system more transparent and less distorting, especially in the allocation of support for industrial enterprises. Both decision-making and the monitoring of the use of funds have been strengthened. Moreover, under some programmes, allocation of state enterprise support has become competitive and explicitly linked to specific, measurable improvements in enterprise performance.

In addition to the system of state subsidies, Belarus also has a pervasive system of directed credits which introduces significant distortions in the allocation of credit. (see chapter 1) The policy advice that international financial institutions have been giving for a number of years is that Belarus should abandon directed credit programmes and pursue industrial policy objectives through traditional fiscal instruments.

The system of support to R&D and innovation shares similarly features and partly overlaps with the system of state subsidies. Firstly, a significant share of state support for innovation is given in the form of repayable loans similar to state directed credits. Secondly, the system of monitoring is also extensive and formalized, as with the system of economic subsidies.

Innovation strategy

The Republic of Belarus has made a clear commitment to an innovation-centred development strategy that seeks to accelerate the transition to a knowledge-intensive, socially-oriented economy. The stronger focus on innovation as a key driver of competitiveness and economic growth is an important characteristic of the growth model adopted by the country from the year 2000 onwards, which is based upon sounder macroeconomic policies and improved incentives for investment and restructuring at the enterprise level. Improved macroeconomic performance since the end of 2000 has been backed up by fiscal consolidation and a reduction in quasi-fiscal activities, especially in the energy sector, growth in labour-intensive sectors coupled with wage and income policies that supported economic expansion by stimulating domestic demand. Consequently, Belarus recorded respectable rates of GDP growth averaging nine percent per year between 2003 and 2008 (see chapter 1). This contributed to the tripling of per capita income and achieving one of the best outcomes in terms of poverty rate reduction in the region.[49] The innovation-centred development strategy has sought to increase labour productivity and energy efficiency, thus counteracting the erosion over time of the country's comparative cost advantages, which have been based upon lower wages. The main target indicators for the innovative development of the Republic of Belarus over the period 2007-2010 are set out in table 16.

[48] World Bank (2009), Belarus: Public Expenditures and Financial Accountability Assessment, Washington, D.C.
[49] World Bank Report (2005), "Belarus: Window of Opportunity to Enhance Competitiveness and Sustain Economic Growth. A Country Economic Memorandum", 8 November 2005.

Table 16. Main target indicators of innovative development of Belarus, 2007-2010

Indicator	Years						Increase 2005-2010
	2005	2006	2007	2008	2009	2010	%
	Reported		Targets				
Share of new products in total industrial output	10.4	11.5	13.0	15.0	17.0	19.0	82.7
Share of innovative enterprises in total number of industrial enterprises	14.1	14.5	17.5	20.0	22.5	25.0	77.3
Share of certified products in total industrial production	68.0	68.0	68.5	69.0	69.5	70.0	2.9
Share of innovative products in total volume of industrial production	15.2	15.5	16.0	16.5	17.5	18.5	21.7
Establishment and certification of quality management systems according to ISO 9001 (with a cumulative total)	658	750	1,000	1,300	1,600	2,000	204.0
Share of expenditure on equipment, tools and equipment in fixed assets	46.9	47.2	47.5	48.0	48.5	49.0	4.5
Number of R&D employees, thousand	30.2	30.7	30.9	31.1	31.3	31.5	4.3
Increase in R&D expenditure from the republican budget	0.37	0.42	0.5	0.6	0.65	0.7	89.0
Internal R&D expenditure	100	121	146	177	214	> 250	> 150.0
Domestic R&D expenditure as share of GDP	0.69	0.85	1.0	1.15	1.3	1.4	103.9

Source: http://www.government.by/public/shared/rus/innovations_p/en/04.html

The main conceptual framework for strategic innovative development in Belarus is set forth in the State Programme for Innovative Development for 2007-2010 (approved by Presidential Decree No. 136 on 26 March 2007, see chapter 2). The overarching aim of the Programme is to build a national innovation system capable of ensuring the generation, dissemination and use of knowledge to generate new products, technologies and services, modernize and upgrade the technological base of the economy, stimulate high-tech exports, achieve import substitution for key products and develop the intellectual potential and creativity of the population.

The Programme targets both basic and applied research, as well as the introduction and dissemination of research results in all socio-economic sectors and the integration of science, education and the industrial base. In addition, the programme aims to support the

development of new institutional and organizational forms of innovation (e.g. competitiveness centres), the competitiveness of large firms and industrial consortia through the development of scientific capacity, and the development of a High-Tech Park.

The programme defines a six level-implementation system (from national to regional)[50] that aims to ensure the participation of all socio-economic actors in the innovation process, as well as several key concepts related to innovation (e.g. new products, innovative enterprises, innovative products, certified products, Quality Management System, number of R&D employees, R&D expenditure, etc.) and the main indicators of innovation development of Belarus for 2007- 2010, as discussed above. Financing sources are discussed in chapter 6.

At the time of writing, a new State Programme for Innovative Development for 2011-2015 was being prepared. A concept has been publicly released, based on the priority directions of S&T activities in the Republic of Belarus for 2011-2015 (approved by Presidential Decree No. 378, 22 July 2010) and 13 priority areas for basic and applied research of the Republic of Belarus[51] (approved by Resolution No. 585 of the Council of Ministers, 19 April 2010). The concept can be viewed as a national strategy of innovation-driven development for 2011-2015 and beyond, aimed at science-based modernization and sustainable development of the country. The 13 new priority basic and applied research areas mark an important shift from the previous set of priority research areas by including, for the first time in the national S&T policy, topics involving interdisciplinary research, as well as new and emerging high risk research.

Each of the 13 broad areas is further specified in 5-12 sub-areas. Moreover, the 2011-2015 SPID specifies a number of concrete targets to be reached by 2015, including:[52]

- Increasing R&D expenditure in high technology three fold from the average annual level during 2008-2010;
- Increasing high-technology exports by 2.5 to 3 times;

[50] The six -level implementation system is defined as follows:
Level I - New businesses and new major products essential for the country's innovative development (national target: 100, of which 22 based on foreign technologies and 78 based on domestic technologies);
Level II - New production (based on new technologies) in existing facilities of strategic importance for the development of industry (national target: 386, of which 68 based on foreign technologies and 318 on domestic technologies);
Level III - Upgrading 609 existing productions through the introduction of 888 advanced (new and high) technologies, including: 96 based on foreign technologies and 792 based on domestic technologies;
Level IV - Implementation of sectoral programmes for innovative development;
Level V - Implementation of the regional innovation development programmes;
Level VI - Implementation of measures for the realization of innovative sections of business plans, development programmes, manufacturing, agricultural and other businesses and organizations.

[51] Energy and energy saving; agro-technology and manufacturing; industrial and construction technology and production; medicine, medical equipment and technology, pharmacy; chemical engineering, nanotechnology and biotechnology; information and communications and aerospace technology; new materials; environmental management, resource conservation and protection in emergency situations; defence and national security.

[52] Statement by Igor Voitov, Chairman of the State Committee for Science and Technology of the Republic of Belarus, expressed in "The Future of the Country Belongs to Innovations", *Economy of Belarus* No. 2, 2010. (http://belarus-economy.by/econom_eng.nsf/all/D45187B6280D6605C225776F004EA732/$File/2.pdf).

- Increasing financial inputs to R&D and innovation activities to at least 2% of GDP and raising expenditure on the material and technical basis of R&D institutions to 10% of total expenses on R&D and innovation activities;
- Increasing the share of innovation products in the total industrial output to 20%;
- Expanding the share of certified products to 80%;
- Reducing the rate of depreciation of active industrial production facilities in operation to 50%;
- Increasing the share of personnel in high and medium-technology sectors to 7%-10% of the total work force; and
- Ensuring the protection of industrial property rights abroad.

The 2011-2015 SPID seeks to further develop the country's innovation system through the improvement of the innovation infrastructure, the support to entrepreneurship and the encouragement of exports of high-tech products. It aims to contribute to the creation of more than 1,500 innovative enterprises. The programme aims to increase Belarusian competitiveness by speeding up economic liberalization, the corporatization of state-owned companies and the creation of integrated innovation organizations.[53]

Innovation legislation

Innovation activities are regulated by a complex set of legislation.[54] Reforms envisage a dual approach:

- Updating existing legislation by introducing amendments and addenda in current laws, such as the Law "On the Basics of the State Science and Technology policy",[55] which allowed for the allocation of national budget funds for improving the material and technical base of the innovation infrastructure, including capital expenditure, and the Law "On S&T information".
- Adoption of new laws and decrees, such as the Innovation Law, the Higher Education Law and the Presidential Decree "On the approval of the provisions for the procedures to establish innovation infrastructure" (No. 1, 3 January 2007). The Innovation Law, which is being prepared at the time of writing, will be important in this respect, as it is expected to specify the principles of state regulation of innovation activities and define basic concepts of innovation (e.g. "innovation policy", "innovation products", "the subject of the innovation activity", "innovation-intensive organization"), the forms and terms of granting state support for innovation, adequate economic incentives for SMEs and large firms to generate and implement innovations, as well as defining a comprehensive legal framework for developing high technology and introducing innovation.

[53] Statement by Igor Voitov, Chairman of the State Committee for Science and Technology at the opening ceremony of the First Belarusian Innovation Forum on 17 November 2009. Available at: http://www.export.by/en/?act=news&mode=view&page=21&id=14801 (last accessed 29 October 2010).
[54] See the list of major legislative acts regulating scientific, technical and innovation activities, as well as the protection of intellectual property on http://www.gknt.org.by
[55] Amendments were introduced by the Law No. 115-3 "On the introduction of changes and amendments in some laws of the Republic of Belarus in management of science, technology and innovation activities" of 4 May 2010.

Efforts to streamline the legislation governing innovative development are focused on:[56]

- Tax legislation, in particular providing substantial tax incentives for research and innovation entities to stimulate R&D;
- Tools to support innovative activities, including by means of facilitating venture capital;
- Introduction of instruments to stimulate the creation and use of industrial property;
- Adequate legal protection of industrial property (inventions, useful models, industrial samples), and other intellectual property; and
- Domestic copyright protection, fulfilment of commitments on protection of foreign copyrights in full compliance with international treaties, improvement of the intellectual property regime.

Specific framework conditions and policy instruments

As already discussed in chapter 2, although the innovation infrastructure of the Republic of Belarus remains at an early stage, it already includes a range of institutions, which have significantly increased in number during the period 2006-2010 (table 17).

Table 17. Development of the innovative infrastructure of Belarus, SPID 2007-2010

	Number of institutions	
	Mid- 2006	**End-2010**
Industrial companies	2,271	2,325
of which, innovation-active companies	*318*	*581*
Scientific-production centres	56	71
Research organizations	295	295
of which, institutions of higher education	*55*	*55*
High-technology parks	1	1
S&T parks	10	20
Innovation centres	5	8
Technology transfer centres	24	30
Business-incubators	9	10
Information and marketing centres	10	30
S&T libraries (including factory libraries)	476	490
Venture organizations	–	3

Source: http://www.government.by/public/shared/rus/innovations_p/en/05.html

A particularity of the innovation support infrastructure of Belarus is that certain innovation support institutions are favoured by specific, supportive framework conditions and policy instruments that seek to provide a further boost to innovation activities and innovative

[56] Statement by Igor Voitov, Chairman of the State Committee for Science and Technology of the Republic of Belarus, expressed in "The Future of the Country Belongs to Innovations", *Economy of Belarus* No. 2, 2010. (http://belarus-economy.by/econom_eng.nsf/all/D45187B6280D6605C225776F004EA732/$File/2.pdf).

development. This very specific feature of Belarusian innovation policy deserves special attention; with the Belarusian High Technology Park providing the most obvious example of this kind.

The High Technology Park was established in 2005 by Presidential Decree, with the aim to boost the competitive power of national new and high technology-based sectors, develop modern technologies and expand their exports, as well as attract both Belarusian and foreign technologies to the IT sector. Currently, the Park "hosts" 84 companies (82 companies and 2 individual entrepreneurs), involved in analysis, design and software development of information systems and technologies and software-based data processing. The Belarusian government is considering the possibility of widening access to the Park to include medical and biotechnologies, nanotechnologies, integrated green technologies and other priority areas. Among the resident companies, 52% were set up by Belarusian investors, 26% by foreign investors (100% foreign capital) and 22% were established as joint ventures. Some performance indicators point to a successful evolution of the Park: for example, in 2008, the total number of goods produced (in terms of activities, services, intellectual property created), increased 1.8 times in comparison to 2007. The average export share in total production is 85%, and doubled in value each year in the period 2005-2008.

In terms of framework conditions, the key attraction of the Park is the preferential tax regime on offer to its residents, who are exempt from duties and taxes to the state budget and non-budgetary funds, income tax, value added tax, customs duties and VAT on imported hardware and other goods necessary for their activities in the Park. In the case of foreign legal entities without a permanent representative office in Belarus, the income tax on the dividends, debts, royalties and licences paid by the residents of the Park is 5%, which applies when no other, more beneficial privileges are stipulated by international agreements of the Republic of Belarus.

Existing regulations stipulate a very broad interpretation of the notion of "residents" of the Park. This category includes not only entities that physically reside on the premises of the Park but all those entities (some of which physically reside outside it), that comply with the Park's objectives and rules and, as a result, have been granted access to its privileges.

Another important benefit is granted to investors in the Park infrastructure and building construction, who will be exempt from land taxes during the construction period, real estate tax, payments for shared participation in the city infrastructure development and compensation to the city administration for the available engineering and social infrastructure. The increased coefficient for the land tax levied in Minsk is not applied to the buildings within the Park.

The dynamic growth of Park resident firms raises several key issues that need to be addressed both at the policymaking and the policy implementation level:

- The shortage of qualified human resources and the tough competition on the labour market for IT experts, which leads to increases in salaries that are not necessarily associated with growth in productivity, and which may affect competitiveness.

- The lack of venture capital and the very limited sources of finance available for IT projects, which is a serious obstacle to progress.
- Most Park residents operate in an outsourcing regime and therefore export IT services rather than a final product. The value added content of exports and the export revenue is lower than in the case of exporting final products.

Technology Transfer Centres and Technoparks may also be carriers of specific framework conditions. These institutions are usually established as small innovative state-owned enterprises that work closely with universities. Universities have the right to create their own technology transfer centres, while Decree No. 252 of May 2010 introduced the possibility of providing financial support from the state budget to universities seeking to commercialize academic research. Technoparks benefit from a 50% reduction in the rent paid for university-provided space, while the profits of companies located on the parks are taxed at only 10% (as opposed to the regular 25%). Technopark activities include business advice, participation in exhibitions, marketing and other forms of support. They are located in all the regions of the country (see table 2.3 in chapter 2) but the highest concentration is in Minsk City.

For example, one of the most important technoparks in Minsk is the Belarus National Technical University Scientific and Technological Park - Polytechnic, which was registered as the first entity of the innovative infrastructure of the Republic of Belarus. Polytechnic is a 100% state-owned enterprise, but can create commercial enterprises where individual scientists are involved as private shareholders, with stakes ranging from 10% to 90%. The Polytechnic has a broad range of tasks, including testing, certification, measurement, improvement of new technologies, transfer of R&D results to the wider economy, creation and support of small innovative enterprises and their involvement in the development and manufacturing of high technology production, market analysis, marketing research and support for the information-marketing network of Belarusian universities, support of university centres for technologies transfer, etc. In pursuing these objectives, Polytechnic has developed contacts with industry partners in a wide range of sectors. Revenues reached $300,000 per annum in 2009, up from $10,000 at the outset.

In principle, technoparks have an important role to play in the transfer of R&D results to the economy and in the creation of innovative start-ups, which are essential to long-term economic growth. However, in practice, these functions remain very limited due to some structural economic and financial constraints. Thus, 100% state ownership is required to guarantee eligibility for funding from state-run programmes but this results in dependence on state funds. A consequence of this situation is that technoparks can offer only modest financial and material support to new start-ups and face difficulty in obtaining funding from bank loans or innovation funds. Improved performance of the technoparks could be achieved through a progressive shift in the primary role of technoparks, from being support structures for specific industrial sectors to key sites for the founding of technology-based firms, providers of specialized technological services and catalysts of knowledge-based regional development. This would require a diversification in the sources of funding and the involvement of non-state actors (see chapter 2).

The higher education sector (HES) de facto operates as a technology infrastructure. The HES offers projects and consultancy services to the industry, through which also university

professors and other staff are incentivized to earn extra income. In this way, universities operate as a compensatory mechanism for the insufficiently developed consultancy services sector. For example, the National Technical University is offering testing services in its five certified labs. In all, this university has around 7,000 contracts worth $8 million. Moreover, every university has a database of its products, and thus de facto operates as a specialized supplier.

Small business support infrastructure and instruments

The country's small business support infrastructure included, as of July 2010, 50 business support centres and nine small business incubators. The typical activities of business support centres include the provision of information and consulting services to small businesses (e.g. legal information, advice on establishing and operating a business, preparation of business plans, market research, assistance in obtaining credit, training).[57]

The Belarusian Foundation for Financial Support to Entrepreneurs provides public financial support to small businesses from the Programme of State Support for Small Business, in the form of preferential loans (some of which are interest-free), property for lease and guarantees for soft loans extended by Belarusian commercial banks. The State can also provide financial support for investment projects and the purchase of equipment, imports and raw materials for domestic production. Support is provided on a competitive basis.

A set of state support measures for SMEs has also been adopted (approved by the Resolution of the Council of Ministers No. 1029, 11 August 2006), with the aim to raise the share of SMEs in the total number of firms in Belarus to 30% during the period 2006-2010. These measures include provisions for the improvement of the regulatory base for SMEs, simplified taxation, strengthening of the business support infrastructure and development of the cooperation between SMEs and other organizations and their interaction with non-profit organizations.

Despite existing measures of support, SMEs and, in particular, new technology-based firms (NTBFs) generally suffer from a lack of dynamism. This is probably symptomatic of broader deficiencies in the business environment, which does not seem conducive to SME growth in general, or to sufficiently encourage inter-firm cooperation and linkages. A sustainable growth of NTBFs will only emerge as a significant economic driver through cooperation with other non-technology-based SMEs and with large enterprises (see chapters 4 and 5).

3.2 The programme-based approach to innovation policy in Belarus

The policy objectives of the 2007-2010 State Programme for Innovative Development are implemented through a number of S&T programmes, which have been developed to address different priority areas (see chapter 2):

[57] In the first half of 2010, around 35,000 entrepreneurs and SME managers benefited from the services of the business support centres. More than 6oo seminars and training sessions were conducted in this context, with the participation of around 16,000 people. The largest share of customers using the services of the business support centres came from the retail sector (29%), followed by production (15.4%), services (11.2%), wholesale trade (6.7%), construction (10.2%), transport services (4%).

- State S&T programmes: address the most significant economic, environmental, social and defence R&D issues at the national level (28 programmes);
- Sectoral (branch) S&T programmes: address specific S&T issues for industry sectors and support the development of new companies and production facilities (nine programmes);
- Regional S&T programmes: address significant S&T issues for the socio-economic development of the regions. They are implemented by the regional and the city of Minsk executive committees; and
- Scientific support and software programmes.

The full list of state programmes for innovation support is given in table 18 (see end of chapter).

This programme-based approach to innovation policy in Belarus has some distinct specificities and features, which constitute both strengths and weaknesses of the system:

There is a high degree of transparency of procedures for proposal submission, peer review evaluation, selection, funding, monitoring and reporting.[58] Bodies that are eligible to submit proposals are the institutes of the National Academy of Sciences, higher education institutions, branch institutes and enterprises with R&D activities. Joint applications are possible. Applications are validated by the branch ministries and submitted to the SCST. The peer-review evaluation is carried out by S&T panels (advisory councils), created by the SCST, that include experts of the National Academy of Sciences, higher education institutions and research organizations. The funding provided within these programmes is non-reimbursable (grant) but only under certain conditions (see chapters 4 and 5). The state contribution of 50% needs to be matched by a 50% contribution from the applicant. The results of the programme implementation are analyzed by the SCST, National Academy of Sciences and the respective state customers. They are included in the annual "Analytical Report on the State and Development Prospects of Science in the Republic of Belarus" presented by the State Committee on Science and Technology and the National Academy of Sciences to the Government and President of Belarus.

Strong emphasis on ex-ante evaluation of projects and weak ex-post evaluation. As a result, there is no clear feedback of evaluation on the next cycle of policymaking: for example, proposals for the State S&T programmes are validated by the branch ministry before being received by the SCST, where they are submitted to a peer review evaluation by S&T panels (advisory councils). However, the evaluation of projects after completion, and programme evaluation in general, appeared less well defined. In principle, state management agencies, other state organizations subordinated to the government and also the National Academy of Sciences are the bodies that carry out the evaluation of the projects implemented by organizations and companies under their auspices. The SCST evaluates the R&D projects implemented by organizations and companies which are not subordinate to the above-mentioned state bodies, and also by individual entrepreneurs. However, there is no

[58] The guidelines explained in detail on the State Committee for S&T website: http://www.gknt.org.by/

information available on programme evaluation or on the impact of the project/programme evaluation on the next policymaking cycle (i.e. during the priority-setting process).

The Belarusian Institute of System Analysis and Information Support for the Scientific and Technical Sphere (BelISA), subordinated to the SCST, is charged, among other tasks, with registering the R&D projects funded under the state programmes and maintaining a State Register of R&D projects. BelISA currently has a database of 68,000 reports on completed projects, which is accessible online by ministries and state departments, and is restricted to individuals submitting a written request. BelISA's monitoring procedure has been improved since 2007, from assessing primarily whether deadlines and financial indicators have been met, to placing a stronger emphasis on the projects' business plans and other output indicators, such as patents. To this end, a new methodology was adopted for the evaluation of innovative projects in 2009. BelISA's monitoring role cannot, however, substitute a formal evaluation of the efficiency of the respective projects/programmes and, further, of the policies that generated them.

Emphasis on structuring by themes defined in the state programmes and poor differentiation by type of research or innovation activities. A Programme is defined in the SCST guidelines as "a set of linked resources, performers, and deadlines for conducting basic and applied research, experimental design and technological activities, culminating in the creation of new or improved technology, various types of commercial products or services, as well as organizational and technical decisions of industrial, administrative, commercial or other nature". While certain types of research activities are considered within this definition (e.g. basic and applied research, experimental design, etc.), the actual structure of the programmes seems to incorporate various categories of research or innovation activities in an undifferentiated manner, with some much better represented than others (e.g. basic and applied research vs. promotion of entrepreneurship), while others are virtually absent (e.g. promotion of clusters). In this context, Belarus could potentially draw on the experience of the European Commission's European Inventory of Research and Innovation ERAWATCH (see box 5).

Strong emphasis on a discipline-based structure of the State S&T programmes with little evidence of interdisciplinary research, particularly in new, high technology areas. The new 2011-2015 State Programme for Innovative Development aims to improve this aspect by introducing for the first time into the national S&T policy, 13 new priority research areas including topics of interdisciplinary research, as well as new and emerging high risk research. Each of the 13 broad areas is further divided between five to 12 sub-areas.

Strong emphasis on the knowledge production side (R&D), but less success on the effective transformation of research results into new products and services (innovation output). This imbalance needs to be addressed along with other key issues, such as the intellectual property regime. The current intellectual property (IP) regime grants the IPRs resulting from state-funded research to the State rather than to the implementing agency, thus reducing the incentive for implementing agencies to commercialize research results (see chapter 5). In addition, the transformation of research results into new products and services requires sources of early stage financial support (see chapter 5). The innovation infrastructure must also provide sufficient economic incentives for the commercialization of R&D results.

Box 5. Categorization of research and innovation measures in ERAWATCH

The categorization of research and innovation activities used by the European Commission's ERAWATCH European Inventory of Research and Innovation measures (shown below) presents one possible alternative restructuring state-funded programmes from a primarily thematic approach to a stronger research/innovation type approach. This would allow a more integrated perspective of research/innovation stages, as well as a stronger emphasis on some types of research/innovation that have received less attention in the current structure:

Types of research activities:

- Basic research
- Problem-driven basic research
- Applied industrial research
- Social sciences research
- Knowledge transfer
- Human resources development
- International research collaboration
- Networking
- Research support activities.

Types of innovation activities:

- Promotion of entrepreneurship (including incubators)
- Innovation awareness-raising amongst firms
- Pre-competitive research
- Applied industrial research
- Development/prototype creation
- Commercialization of innovation (including IPR)
- Industrial design
- Promotion of cooperation and clustering
- Diffusion of technologies in enterprises
- Innovation management tools (including quality).

Source: ERAWATCH European Inventory of Research and Innovation measures (http://cordis.europa.eu/erawatch/index.cfm?fuseaction=search.advsearch&type=3).

An excessive focus on the transfer of R&D results from R&D institutions to the enterprise sector (extra-mural innovation activity), rather than on R&D performed by the business enterprise sector itself (intra-mural innovation activity). This stems from an economic system that relies heavily on administrative mechanisms of control, together with an unreformed R&D system. Consequently, enterprises are not typically the agents driving the innovation process, with the possible exception of certain sectors such as the machine building and metallurgy sectors. The policy concern with ensuring transfer of innovation from the R&D sector into production is a natural consequence of an administrative system still based largely around extra-mural innovation activity.

An interesting feature of Belarusian innovation policy is its significant emphasis on technological development through import-substitution. This goal is supported by a specific state programme. The available evidence, while fragmented, suggests that there have been some cases of initial import substitutions going on to become successful exporters. A full evaluation of the ex-post outcomes and effectiveness of this programme would be useful.

A policy focus on new technology based firms has been a recent development, and stems from a greater understanding on the part of policymakers that Belarus needs these types of firms to pursue an innovation-based growth strategy. These firms are necessary as both independent sources of growth as well as a sector of specialized suppliers needed to provide the foundations of growth for larger firms.

Limited importance of regional S&T programmes. While the importance of regional considerations is recognized in the current policy set-up (see chapter 2), these regional S&T programmes have great potential to support more balanced growth in all regions of the country, and correct the regional disparities that deepened during the period of economic transition. To this end, it is essential to ensure that regional inequalities are not perpetuated through certain reinforcing mechanisms (fiscal policy, labour market). Therefore, it is necessary to ensure that the implementation of regional S&T programmes is closely coordinated with other national/regional programmes (e.g. in the areas of transport, industrial competitiveness, environment, rural development and human resources), so as to strengthen the specific local and regional dimensions. This is one means of facilitating the various regions to capitalize on their specific resources, meet local needs and follow diversified development paths based on their history, strengths and resources.

Accessibility of state S&T programmes by SMEs. In principle, State S&T programmes are open to all innovation actors (R&D institutes of the National Academy of Sciences, branch R&D institutes, higher education institutions, enterprises with R&D activities, etc.). In practice, however, there appears to be an intrinsic difficulty for SMEs to participate in State S&T programmes. This arises on the one hand from the challenge of providing the required 50% co-financing (due to limited own financial resources and great difficulty in obtaining bank loans), and on the other hand, competition for limited state funding from the 'big' players - e.g. the NAS R&D institutes or the large firms. In addition, the paperwork required, together with the pressure of repaying research grants to the national budget in cases where the commercialization of project results does not take place within three years of project completion, frequently deters SMEs from applying for funding. This effect could be counteracted through the promotion of specific measures/programmes for innovative SMEs, alone or in partnership with other innovation actors.[59]

[59] For an overview of existing innovation support measures targeting SMEs see UNECE (2009), Enhancing the Innovative Performance of Firms: Policy Options and Practical Instruments. Geneva and New York; UNECE (2007), Financing Innovative Development. Comparative Review of the Experiences of UNECE Countries in Early-stage Financing. Geneva and New York.

3.3 Recommendations

Belarus has accumulated valuable and unique experience in establishing framework conditions conducive to innovation, albeit with a limited degree of applicability. The experience of the Belarusian High Technology Park is one example of this kind, with highly encouraging outcomes. Nonetheless, this success has been facilitated by the granting of special privileges to the resident companies of science parks. The fact that such policies are applied to only limited parts of the NIS results in the formation of favoured "enclaves", with limited incentives for resident companies to "graduate", as doing so would imply forgoing such benefits.

Recommendation 3.1

Learning from the positive experiences of encouraging innovation in science and technology parks as well as in special economic zones, the authorities could consider expanding some framework conditions conducive to innovation to the whole economy:

- *Innovation-related tax incentives could be applied across all sectors and industries and beyond the auspices of science and technology parks;*
- *Similarly, incentives associated with the innovative activities of foreign firms could also be applied throughout the economy; and*
- *Specific policy instruments and institutions could be created to facilitate the graduation of innovative start-up firms from innovation support institutions, their integration in the economy and future growth.*

State funding plays an important role in channelling resources for innovation activities in Belarus. The increased used of competitive procedures to allocate these resources is a positive development that has increased the efficiency of spending decisions. However, it is important that policies encourage not only competition between applicants for state resources but also reward cooperative arrangements, in particular, with the participation of SMEs.

Recommendation 3.2

Public initiatives to support cooperative arrangements in pursuing innovation activities and projects, in particular, with the participation of SMEs could be strengthened through initiatives and policy instruments that:

- *Facilitate and encourage the access of innovative SMEs to state science and technology programmes;*
- *Stimulate and facilitate partnerships between SMEs and other innovation stakeholders, including state-owned enterprises, R&D and academic institutions;*
- *Encourage various forms of business and administrative support to SMEs; and*
- *Improve the public perception of entrepreneurship.*

Belarus has developed a wide range of initiatives to foster innovation, including the State Programme for Innovative Development for 2007-2010, which will be followed by a new

programme for the period 2011-2015. Such a complex and far-reaching set of measures provides a significant scope for drawing lessons from past experiences, thus contributing to the effectiveness and coherence of future actions. Belarus' own policy experiences provide a rich learning ground that could be better exploited. Such an element could make an important contribution to increasing policy effectiveness, while taking into account national circumstances.

Recommendation 3.3

The comprehensive evaluation of the outcomes of past policy initiatives and measures, and the extent to which they meet the policy objectives and targets needs to become part and parcel of policymaking and implementation. To this effect the authorities could:

- *Expand the evaluation focus of programmes, projects and policy instruments to include an ex-post evaluation (which combines quantitative and qualitative assessments) of the degree to which they meet the policy objectives and targets;*
- *Incorporate elements that facilitate subsequent ex-post evaluation at the early stages of designing programmes, policy initiatives and instruments;*
- *Effectively use the feedback received from ex-post evaluation in the next cycle of policy-making; and*
- *Request an independent international evaluation to identify areas of international excellence as well as areas where there are weaknesses and others that offer great potential for further development.*

The regional dimension of innovation policies is an important consideration, which is recognized in the current policy set-up. In addition, innovation policies can contribute to a more balanced regional development and the correction of regional disparities. This acknowledgement is a good starting point for a further strengthening of the policy linkages between innovation and regional development issues.

Recommendation 3.4

Building on past achievements, the authorities could devote further efforts to develop the regional dimension of innovation policies. Specific policy initiatives could target:

- *Increasing the scope and outreach of regional programmes, transforming them from science and technology programmes to programmes of regional innovative development; such an expansion should be backed by additional resources;*
- *Ensuring better coordination between regional innovation programmes and other regional initiatives (e.g. transport, industrial competitiveness, environment, rural development and human resources);*
- *Encouraging a bottom-up approach in regional innovation programmes, thus complementing the dominant top-down national development approach; and*
- *Strengthening collaboration between regional innovation stakeholders and enhancing the capacity of regional authorities to manage and coordinate innovation projects.*

Table 18. List of State-funded S&T programmes

1	**State S&T Programmes**
1.1	State S&T Programme "Protection of documents"
1.2	State S&T Programme "Therapeutic and Diagnostic Technologies
1.3	State S&T Programme "Infectious diseases and microbiology biotechnology"
1.4	State S&T Programme "Protection from emergency situations"
1.5	State S&T Programme “CALS-technologies”
1.6	State S&T Programme "Engineering"
1.7	State S&T Programme "Technologies and equipment engineering"
1.8	State S&T Programme "Electronics"
1.9	State S&T Programme "Microelectronics"
1.10	State Science-Technical Programme Standards and scientific instruments"
1.11	State S&T Programme "Energy 2010"
1.12	State S&T Programme "Nuclear Physics Technology”
1.13	State S&T Programme "New Medicines"
1.14	State S&T Programme "City Services"
1.15	State S&T Programme "Building materials and technology"
1.16	State S&T Programme "Optotech"
1.17	State S&T Programme "Resource-2010"
1.18	State S&T Programme "New Materials and Technologies"
1.19	State S&T Programme "Information Technology"
1.20	State S&T Programme “Industrial Biotechnology”
1.21	State S&T Programme "Agropromkompleks - Rural Development"
1.22	State S&T Programme "Belselhozmehanizatsiya"
1.23	State S&T Programme "Ecological Safety"
1.24	State S&T Programme “Management of forests and sustainable forest management"
1.25	State S&T Programme "Chemical and production"
1.26	State S&T Programme "Information Security"
1.27	State S&T Programme "Creation of advanced tools and systems, radio communications and the development of their production in the Republic of Belarus for 2007-2010"
1.28	State S&T Programme "Centrifugal equipment"
2	**Sectoral /branch S&T Programmes**
2.1	Industrial S&T Programme "Mother and Child"
2.2	Industrial S&T Programme Medical Rehabilitation and expertise"
2.3	Industrial S&T Programme "Medical Ecology and Health"
2.4	Industrial S&T Programme “Education and Health”
2.5	Industrial S&T Programme “Culture”
2.6	Industrial S&T Programme "Scientific software development for the flax industry"
2.7	Industrial S&T Programme “Textile and knitted technology"

Table 18. List of State-funded S&T programmes *(continued)*

2	**Sectoral /branch S&T Programmes *(continued)***
2.8	Industrial S&T Programme Potato starch"
2.9	Industrial S&T Programme "Food for the elderly"
3	**Regional S&T Programmes**
3.1	Regional S&T Programme of the Brest region, "Systems, machines, service 2006-2010"
3.2	Regional S&T Programme "Innovative development of the Vitebsk Region"
3.3	Regional S&T Programme "Scientific and technical support for socio-economic development of the Gomel Region"
3.4	Regional S&T Programme "Sustainable Development: Science, Innovation, Technology Grodno region
3.5	Regional S&T Programme "Development of Minsk Region"
3.6	Regional S&T Programme "Development of Mogilev"
4	**Scientific Support and Software Programmes**
4.1	The Presidential Programme "Children of Belarus" (Scientific Support)
4.2	Government Programme (Scientific Support)
	- State Programme of import substitution
	- State Programme "Belmedtekhnika"
	- State Programme "Fruit"
	- State Programme "Development of the production of veterinary drugs and instruments used in veterinary medicine"
	- State Programme Information "Electronic Belarus"
	- National Programme of Demographic Security of Belarus
	- State Target Programme “Monitoring of the Earth’s polar regions and maintenance of the Arctic and Antarctic expeditions in 2007-2010 and during the period to 2015”
	- State Programme of creating a single information state statistical system of the Republic of Belarus
	- State Programme "Development of Physical Culture and Sports of the Republic of Belarus"
	- State Programme "Establishment of a national genetic stock of economically useful plants"
	- National Programme for the production of new and high technologies
	- National Programme for reconstruction of the Central Botanical Garden of NAS of Belarus
	- State Economic Programme "Phytopreparations"
	- State Programme "Biotechnology"
	- State Programme "Plant Protection Chemicals (Pesticides) for 2008-2013"

Chapter 4

KNOWLEDGE GENERATION AND TRANSFER

This chapter first provides in summary form some stylized features of knowledge generation in Belarus. This is followed by an analytical overview of selected key issues in this area, in particular regarding the role of the enterprise sector and the system of public funding of R&D. This serves as the basis for drawing conclusions and formulating policy recommendations.

4.1 The system of knowledge generation

Some stylized features of the process of knowledge generation in Belarus

As discussed in chapter 1, Belarus is a highly trade-dependent economy which operates through a specific mix of administrative incentives. These specificities have also left their footprint on the process of knowledge generation.

In a market-driven economy, innovation is considered as an expression of market forces interacting within the National Innovation System, which also includes public innovation policies. Moreover, in a well functioning market economy, innovation is a technological but also social and economic process shaped by the joint working of market forces and state regulatory activities. Innovation cannot be fully regulated by state policy measures and activities. In fact, market demand and market competition are the final 'filtering mechanisms' of innovation activities.

In Belarus, the presence of strong administrative levers has a perceptible effect on the process of knowledge generation and innovation activities in general. A related issue is that innovation in the existing system of incentives is to some degree perceived as an *object*, as opposed to a *property* of the innovation system which can only partly be shaped by state policy. Belarusian innovation policy is quite elaborate in its objective to regulate, stimulate and create incentives for innovation activity in all its stages: from R&D to transfer and implementation of new technologies. This seems to reflect a traditional view that state management of innovation activities can effectively substitute for the actions of market actors, including a competitive business environment and the independently created innovation strategies of large and small firms.

However, the understanding of the importance of market forces is being gradually recognized in the context of Belarusian innovation policy. For example, the need for both mechanisms – state and market – has been acknowledged in the methodological preparations of the State Programme for Innovative Development of Belarus in 2011-2015, which points out that "… particular attention … must be paid to the justification of the key directions and measures

for state regulation of innovation processes taking into account the use of market mechanisms of self-regulation'.[60]

A further acknowledgement of the role of the market environment in innovation-based activities is Presidential Decree No. 123.[61] This Decree removes all administrative controls over prices and business practices of legal entities producing high-technology products and services until two years from the beginning of this production. This partial and temporary liberalization of the business environment is recognition of the powerful role of market incentives, although in this case it is limited to organizations that do not benefit from state funding.

The role of the enterprise sector in knowledge generation

Given the prevailing socio-economic and policy environment, it can be pointed out that research and development as such is an important focus of Belarusian innovation policy. However, the existing R&D system in Belarus features some important specificities:

- The R&D system is to a large degree focused on science and technology rather than only on R&D proper;
- R&D is almost entirely conducted in state-owned research organizations; and
- The major source of R&D and new technology is extra-mural R&D (i.e. R&D performed in specialized institutes), not enterprise-based R&D: extra-mural R&D organizations account for 71.45% all R&D undertaken in Belarus (see the statistics presented in chapter 1 and the discussion in chapter 2).

Therefore, at present, enterprises are not the major agents of the innovation process in Belarus. The business sector is to a large degree dependent on the R&D system to solve major technological problems, and on line ministries to provide funding for innovation and modernization. On the other hand, Belarus is a catching-up economy that is highly dependent on foreign technology inflows in terms of foreign embodied technology (equipment) and intangible knowledge (software). In short, the role of the business sector in the innovation process can be summarized as follows:

- Knowledge is generated through cooperation between extra-mural R&D organizations and firms;
- Imports and limited purchases of licences are major channels of knowledge inflow for the business sector; and
- Learning by exporting is also an important channel for knowledge transfer, especially with regard to exports to the highly competitive markets of developed market economies.

[60] State Committee on Science and Technology of the Republic of Belarus (2010), Draft Methodological recommendations for the elaboration of the Programme for Innovative Development of the Republic of Belarus for 2011-2015.
[61] Presidential Decree No. 123 'On some measures to stimulate innovation activity in Republic of Belarus', 9 March 2009.

For a considerable period of time, the administrative regulatory regime in Belarus was not particularly favourable to new business entries to the market. However, notable progress has recently been made in terms of deregulation, particularly in relation to the establishment of small firms (see chapter 3). For example, since February 2009, a one-day registration policy for enterprises and individual entrepreneurs has been introduced.[62] As a positive outcome of the process of administrative deregulation, the number of SMEs has doubled in the past five years.

The line/sectoral ministries are major focal points for innovation planning at a disaggregated level, and so the State Programme for Innovative Development may be regarded as a compilation of sectoral plans. Strong pressure to innovate and modernize comes from enterprises that are forced to compete on foreign markets, and hence productivity improvements within existing firms have been a major source of growth in Belarus.[63] Partly as a result of this, sectoral innovation plans often sometimes contain modernization elements (new fixed investment) and innovation projects (see chapter 2).

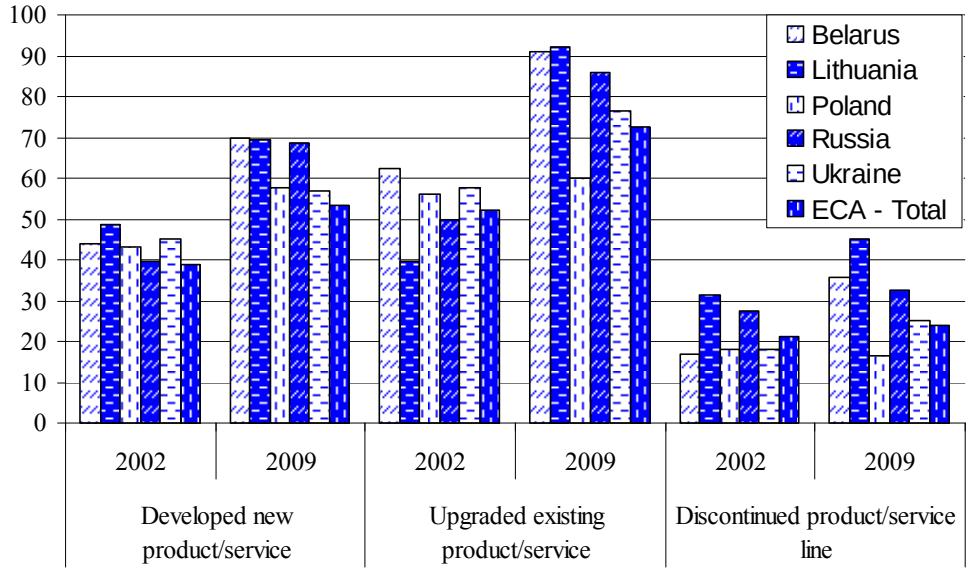
At the individual enterprise level, restructuring activities within firms are quite extensive and comparable to economies that have undergone quite different patterns of transition. Figure 6 illustrates this process of extensive product restructuring. As can be seen, the capacity of Belarusian firms to change unviable lines of business and upgrade or launch new lines of business, all of which is tantamount to innovation activity, is comparable to that in neighbouring countries.

The evidence presented in figure 6 confirms a high degree of product level restructuring in Belarus, despite rather extensive administrative intervention in the economy. While this may be surprising at first glance, it suggests that targeted interventionist measures in Belarus have been quite effective in achieving their objectives. The mechanisms by which this has been achieved are classified by the World Bank as:[64] i) competitive allocation of state enterprise support, including directed credits, (ii) high transparency and accountability in the allocation of state support, (iii) an elaborate system of controls and penalties for rent-seeking and asset stripping, and (iv) the government's official trade diplomacy that provided Belarusian enterprises with important export support in Russia.

These targeted interventionist measures have therefore proven their role as effective alternative disciplining mechanisms in Belarus. They have been able to impose discipline on firms, and reduce corruption and rent seeking behaviour:

[62] EBRD (2009), Transition Report, London.
[63] World Bank (2010), Belarus. Industrial Performance Before and During the Global Crisis, Belarus Economic Policy Notes: Note No. 1.
[64] World Bank (2010), ibid.

Figure 6. Restructuring activities of enterprises in selected economies, 2002 and 2009



Source: Based on World Bank (2010), Belarus. Industrial Performance Before and During the Global Crisis, Belarus Economic Policy Notes: Note No. 1.
Notes:
[i] Based on 2002 and 2008/9 EBRD-World Bank Business Environment and Enterprise Performance Survey and definitions in Mitra, Pradeep, Alexander Muravyev and Mark E. Schaffer (2009). Convergence in Institutions and Market Outcomes: Cross-country and Time-series Evidence from the Business Environment and Enterprise Performance Surveys in Transition Economies. World Bank Policy Research Working Paper 4819.
[ii] "Developed New Product/Service" is considered as the deepest restructuring measure, followed by "Upgraded existing product/service".
[iii] "Discontinued product/service line" is an indicator of defensive restructuring.

An additional specificity of the Belarusian innovation policy mix – and the associated administrative system – is the widespread use of "moral suasion" as a tool to drive innovation. There is a pervasive policy-driven "pressure to innovate", as demonstrated by strategic documents and instruments. While this approach *de facto* aims to 'plan innovation', it also conveys strong signals to all participants in the innovation process of the high policy priority assigned to this process. The strong policy drive has been partly facilitated by the high concentration of industry. For example, 100 large enterprises provide 27% of all tax revenues for the budget, while 10 large enterprises produce 40% of all industrial production.[65] The effectiveness of the administrative policy approach and of its mechanisms has been supported by a relatively high degree of transparency and accountability that seems to permeate the Belarusian administrative system.

At the same time, these outcomes may not seem so surprising if one bears in mind that Belarusian exports of manufactured goods are largely oriented toward 'softer' CIS market segments where cost competitive functional and design improvements (implemented to a large degree through administratively driven policy mechanisms) remain able to find

[65] V. Davidovich, T. Tatyanko (2010), National Innovation System of the Republic of Belarus, memo.

customers. However, with further liberalization and opening up of these economies and their expected increases in purchasing power, such attributes are likely to become less attractive to customers, presenting a challenge to Belarusian exporters. Moreover, very few of the new products introduced by means of administrative "push" make their way to the highly competitive and demanding markets of developed market economies.

As a consequence, and as mentioned in chapter 1, there is empirical evidence that the last few years have seen Belarusian exports losing competitiveness. Therefore, even if data on restructuring activities (figure 6) represent the genuine extent of innovation activity, their intensity does not seem to be strong enough "to exert any significant impact on enterprise export capabilities".[66] This presents a clear signal that current – largely administratively driven – innovation policy may have reached its limit in Belarus.

A high share of intra-firm activity as a source of productivity growth together with the large scale of active restructuring activities suggest that learning in large Belarusian firms is largely within-the-firm, with limited interaction between large and small firms but relatively stronger links with extra-mural R&D organizations.

More intensive product and process innovation would be required for further growth but this cannot be achieved through within-the-firm activities alone. Healthy market dynamics can arise only through stronger competition leading to the generation of new business and organizational models. Administrative incentives are not effective in instigating such changes, which imply a high degree of autonomy of enterprises and new types of managerial and entrepreneurial skills.

As already pointed out, a key feature of the Belarusian NIS is the high share of state funding of R&D in the business enterprise sector, which itself is to a large degree state owned. In turn, state funding is closely tied to extra-mural R&D organizations that carry out R&D for the business enterprise sector, rather than R&D being carried out within enterprises. International comparisons indicate that, in countries with per capita income above $15,000, the business sector is the dominant source of funding and performer of R&D.[67] In economies below this "threshold level" (such as Belarus), there are a variety of organizational models. Belarus belongs to the most numerous group where the government is the major funder, while the enterprise sector is the dominant performer. This has strong implications for Belarusian economic policy, where the objective is to double income per capita in the next five years. Achieving this objective should be associated with major changes in the R&D model and with the enterprise sector becoming the major funder of R&D. This would require a thorough restructuring of the R&D system.

The system of public funding of knowledge generation

A cornerstone of the Belarusian innovation system is public funding of R&D. In some countries with economies in transition, the public R&D system has shifted more towards

[66] World Bank (2010), ibid.
[67] S. Radosevic (2011), Science-Industry Links in CEE and CIS: Conventional Policy Wisdom Facing Reality, Science and Public Policy, August, (forthcoming).

funding basic and applied research as these are activities where state funding can be justified. In other transition countries like Belarus the R&D system has been subject to very strong commercialization pressures or the need to support innovation in the enterprise sector. This has led to changes in the structure of R&D activities towards development and services activities and to the relative decline of basic and applied research activities, which is especially manifest in Belarus where this share has fallen to 36% of total R&D activities in 2008 (table 19). This may seem appropriate in the short-term but in the long-term it may undermine research proper.

Table 19. Types of activities within the R&D system of selected economies, shares in per cent

	Basic research		Applied research		Development		Services	
	2005	2008	2005	2008	2005	2008	2005	2008
Azerbaijan	29	21	48	42	11	22	12	15
Armenia	15	18	6	5	69	69	10	8
Belarus	18	13	26	23	46	53	10	11
Kazakhstan	14	11	33	40	44	20	9	29
Moldova	28	24	35	49	34	26	3	1
Russia	13	18	15	18	65	58	7	6
Tajikistan	85	49	4	27	8	18	3	6
Ukraine	20	25	15	19	50	46	15	10

Source: SCST (2009), Science, innovation and technology in Belarus 2008, Minsk.

Belarus has a very elaborate system of state support for technical modernization and production-led innovation. At its core is the set of programmes assembled in the State Programme for Innovative Development for 2006-2010, to be followed by a new one for 2011-2015. This system has been described in chapters 2 and 3.

This planning framework seems quite elaborate and reflects a system where enterprises do not have sufficient autonomy and are strongly reliant on the sectoral administrative structure in the innovation process. On the other hand, such a system has a strong built-in bias towards technically proven and low risk projects which paradoxically yields “an anti-innovation bias”, despite the strong policy focus on innovation, for reasons which are explained below (see also discussion in chapter 5).

Levers and incentives in the process of knowledge generation

State science and technology programmes provide an opportunity for co-funding of product development from the state budget of up to 50% of total development costs, the remainder being funded by the companies that will produce the product. If a project is not successful, public funding has to be reimbursed to the budget. Due to this high penalty for failure, these

programmes have an in-built bias towards low risk projects, which are equivalent to projects of relatively limited innovative content (genuinely innovative projects are by their nature high risk). Hence, the system of incentives in these programmes contains an anti-innovative bias.

In addition, the system is somewhat rigid in cases where there is a need to make changes during the course of a project, for example, when additional R&D is needed or when there are problems with commercialization. Thus, if sales of newly developed products are not commenced within three years of its completed development, funds from the national budget spent on product development are deemed to have been inefficiently used and should be reimbursed to the national budget. If, within the period specified by the programme, sales do not reach the scale envisaged by the programme, the funds should be also partially reimbursed. The amount to be returned is calculated on the basis of the share of budget financing and the degree of success in meeting sales targets. These conditions further reinforce the bias in favour of technically proven and low risk projects.

As commented by interviewees, "the current system guarantees that there will be no misuse of funds but at the same time there is zero tolerance of risk, so there is a trade-off". As a result some enterprises have given up participation in state programmes, considering the conditions in the latter as "too tough". Unlike enterprises, research institutes do not have many alternative options due to their financial constraints, and so are less likely to stop participating. At the same time, in goal-oriented programmes, research institutes are funded fully, unlike enterprises which have to match fund projects at a rate of 50%. So, the outcome of current system is that it leaves enterprises to fund high risk projects from their own resources, while providing support for 'low hanging fruits' i.e. for technically proven projects.

In addition, the tough rules for repayment of funding in case of failure are not counterbalanced by gains in terms of revenues from intellectual property rights (IPR) for innovators. In accordance with the legislation, all IPRs generated under state-sponsored programmes belong to the State, except in cases where the technology is fully developed by an enterprise (see chapter 4). However, in the case of state-owned enterprises, there is also state control. While this situation may seem logical and fair from the perspective of protecting public funds and taxpayers, such controls may have the effect of hindering technology diffusion and the flow of knowledge within the country. For example, one interviewee mentioned that "in Belarus, no private enterprise has bought any Belarusian technology as it is too expensive".

Due to the limited incentives to generate IPR-protected products, many enterprises do not patent R&D results as they do not see the benefits. As interviewees explain, "Once they receive royalty they will be asked by the State Committee to return the money". As a result, the market for technology is very small. In 2008, there were only 683 contracts for the sale of licences. The export of licences amounted to $96 million, with imports of $181 million, most of which is accounted for by engineering services.

Another source of R&D funding is innovation funds collected from enterprises. Each line ministry has its innovation fund from the "innovation tax" which amounts to 0.25% of enterprises' turnover. Some ministries can, at their discretion, impose much higher rates of as much as 10%. Enterprises that do not participate in funding cannot benefit from these

programmes. One part of this funding is for the use of contributing enterprises, while another part goes towards innovation funds controlled by the sectoral ministries and to the Belarusian Innovation Fund. Chapter 5 discusses further the role and characteristics of these innovation funds.

Table 20 shows the shares of different innovation funds according to their areas of use in 2008. Notably, R&D proper amounted to only 11% of overall expenditures of sectoral innovation funds The largest individual category is "other objectives" with a share of 20.6%, followed by construction and reconstruction of buildings, energy saving programmes and purchase of equipment. Therefore, the majority of funding is allocated to modernization projects, as well as for a variety of purposes which are not directly related to innovation.

Table 20. Innovation funding by area of use, shares in per cent, 2008

Area of use	**Funding share, %**
Funding for research, experimental design and technological works and works on the preparation and development of new types of high-tech products	11.0
Creation and development of industries based on new and high technologies	2.5
Construction and reconstruction of buildings, engineering, communications and transport facilities	19.0
Purchase of equipment not included in the estimates of construction projects	11.9
Energy saving programmes, measures to introduce new energy-efficient technologies and equipment	13.4
Construction of houses and of engineering and transport infrastructure for housing estates	3.9
State Programme of Rural Development for 2005-2010	2.7
Payment of interest on loans to banks of the Republic of Belarus	3.1
Repayment of sums borrowed under the guarantee of the Government of the Republic of Belarus to foreign credits and loans to banks	8.2
Financing on recovery basis through the Belarusian Innovation Fund	1.5
Marketing research, publications in the field of standardization and certification of products	0.9
Development of Scientific and Technical Information	0.27
Development of material-technical base of subordinate organizations	0.03
The content of the central offices of national government bodies	0.7
Develop business plans for organizations	0.02
Compensation for loss of income - citizens to install phones on concessional terms	0.003
Other objectives	20.6

Source: http://gknt.org.by/rus//innovations/innofounds/

Evaluation

Another important element for effective public funding is the system of evaluation of individual researchers, programmes, projects and institutions. In the absence of a robust system of evaluation, there is always a danger of disconnection from societal needs,

a tendency to pursue internally generated agendas and strategies, and risks to quality and efficiency resulting from lack of external competition in the allocation of research funding.

The interviews conducted during the *Review* mission in Belarus suggest the following conclusions regarding evaluation. First, the evaluation system is primarily oriented towards *ex-ante* screening (i.e. towards the selection of projects), while much less attention is paid to *ex-post* evaluation. For example, the monitoring of state science and technology projects is assigned to the state agency BelISA,[68] which is subordinated to the SCST. Initially, its monitoring system was based solely upon administrative criteria such as actual funding, deadlines met and formal compliance. Since 2007, BelISA has also paid attention to outputs such as patents. The SCST can involve experts in the evaluation of final results. During a three year post project period, the SCST is tracing projects via compulsory reporting. Staff collect report forms at six month intervals on the results of 1,200 current projects, reporting back to the SCST. The system is highly formalized: for example, it requires the generation of 68,000 reports on 1,200 science and technology projects against 17 indicators used to monitor projects.

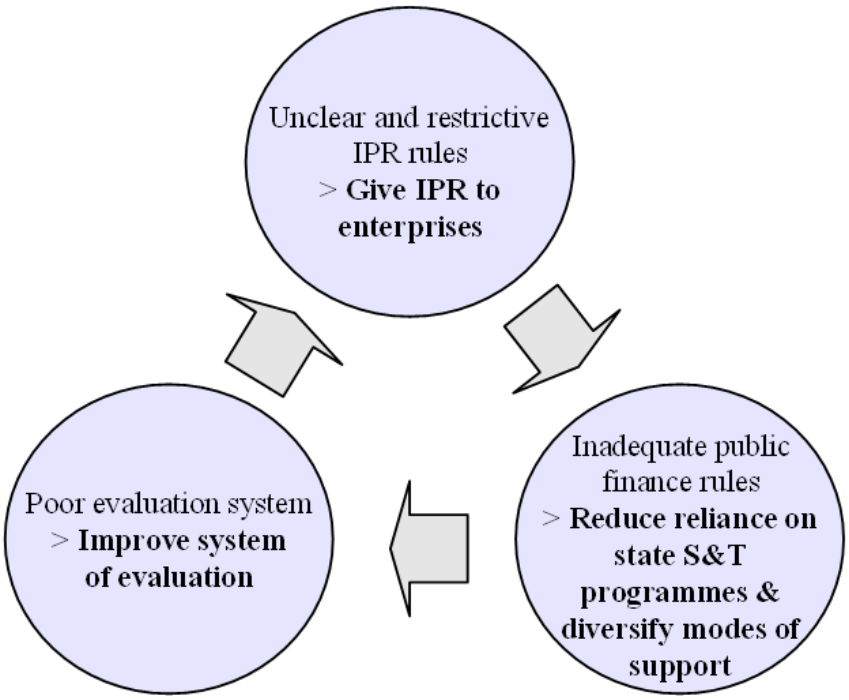
Second, the system of selection is designed as quasi competitive, i.e. it is based on a procedure whereby independent experts provide the basis for final selection by panels. The evaluation methodology is quite similar for rather different types of projects (basic, applied, engineering and design, commercialization). Third, there is no system for the evaluation of programmes, only for the evaluation of projects. But even if such a system existed, it would have been problematic due to the lack of a clear separation of functions between funding agencies and policymaking bodies. In the Belarusian system, the functions of "principals" (the National Academy of Sciences, the SCST and the line ministries) are often combined with those of "agents", as these are often also the funding body; in some cases, research institutes act as programme coordinators that coordinate national programmes. Chapter 3 discusses further the role of evaluation in innovation policies in Belarus.

Summary

The analysis of the state funding of knowledge generation and innovation has identified some problems that reduce the effectiveness of the national innovation system. These problems can be separated into three groups of factors that are mutually connected. Unclear and restrictive IPR rules are coupled with inadequate public finance rules for innovation projects, which are in turn linked to a poor evaluation system. It is difficult to change one of these three elements in isolation. For example, changing public finance rules without changing the IPR system would not lead very far. Likewise, changing the current system of evaluation without changing public finance rules would also be ineffective. It is important to note that none of these elements, if changed on its own, will deliver the required "step change". It is therefore necessary that policy measures to improve the efficiency and effectiveness of the NIS should simultaneously target improvements in all three groups of policy issues (see figure 7).

[68] The Belarusian Institute of System Analysis and Information Support of the Scientific and Technical Sphere (BelISA).

Figure 7. From vicious to virtuous cycle: public funding of R&D in Belarus



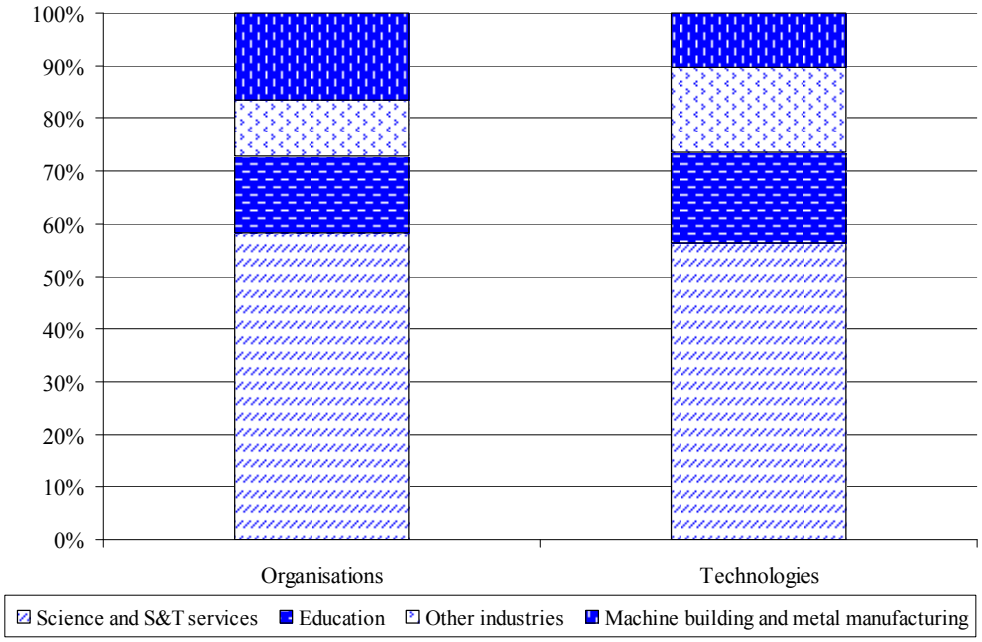
4.2 The system of knowledge transfer

Domestic capacity to absorb and diffuse knowledge and technology

Knowledge generation is one of four major functions in the innovation system. The other functions are knowledge diffusion, absorption and demand. Knowledge diffusion and absorption, while being important internal features, are also to some extent external features of the NIS. In other words, its ability to absorb and diffuse technology and knowledge from abroad is equally important as the inward diffusion and absorption capacity.

The strong extra-mural nature of the Belarusian R&D system has led to inward technology transfer becoming a prime issue in innovation policy: with R&D being mainly generated outside enterprises, its transfer and introduction into the business enterprise sector represents a major policy objective. The sector of 'science and science and technology services' represents the major economic segment engaged in the transfer of production technologies (figure 8). Other important sectors are universities and machine-building and metal manufacturing, while the remaining sectors seem to be quite marginal as sources of transfer of production technologies.

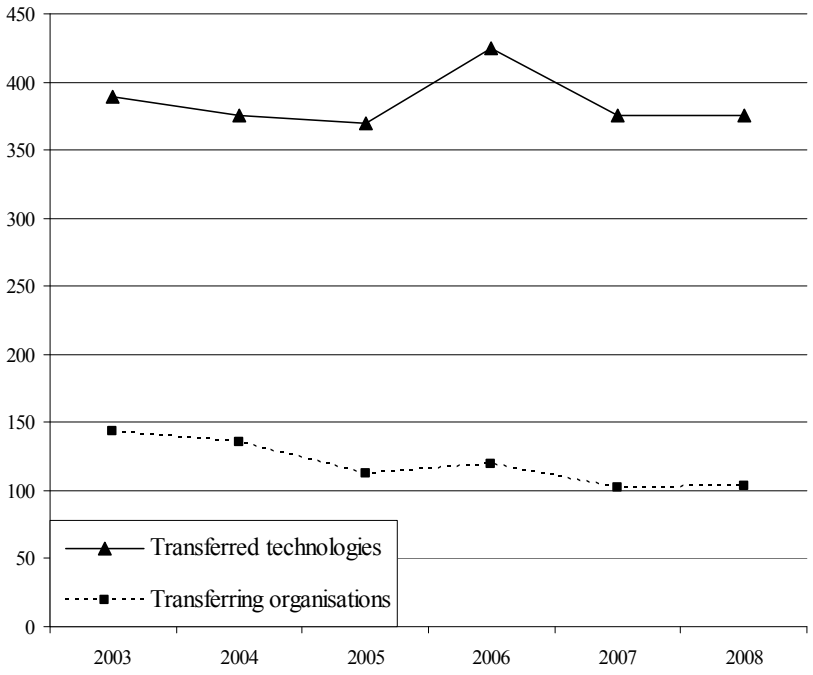
Figure 8. Transfer of production technologies by sector, shares in per cent, 2008



Source: SCST (2009), Science, innovation and technology in Belarus, 2008, Minsk.

In terms of the number of organizations transferring production technologies and the number of transferred production technologies, there has been a downward trend in recent years (figure 9).

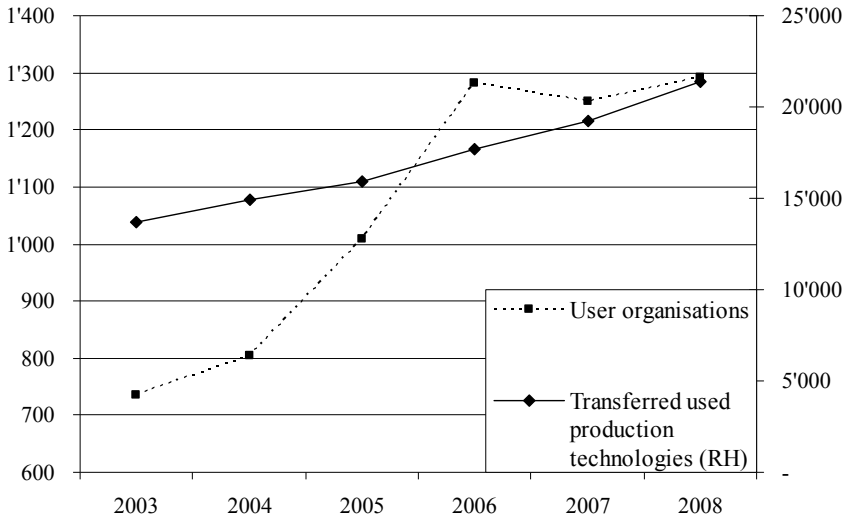
Figure 9. Number of transferred production technologies, 2003-2008



Source: SCST (2009), Science, innovation and technology in Belarus 2008, Minsk.

Nonetheless, from the users' perspective, the number of transferred used production technologies and the number of organizations making use of these has been increasing continuously (figure 10). Their technical quality, as measured by the number of inventions embedded within transferred used production technologies, has also been increasing though at a somewhat lower rate. This suggests that although the number of source organizations has been declining, use and diffusion have been increasing.

Figure 10. Number of users of transferred production technologies, 2003-2008



Source: SCST (2009), Science, innovation and technology in Belarus 2008, Minsk.

Table 21 below shows that the major sector-users of production technologies and inventions are machine-building and metal manufacturing, food industry and science and science and technology services. Machine-building and metal manufacturing and science and science and technology services are important as both suppliers and as users of innovations, although the science sector is largely involved through R&D activities rather than through innovations. Machine building is also the business enterprise sector with the strongest intra-mural R&D, and hence its strong role as both a user and producer of innovations is logical. The relatively weak linkages with other sectors points to some general weaknesses of the administrative system in terms of horizontal knowledge flows.

In market economies, the major mechanisms of learning and diffusion of knowledge are market-mediated interactions between firms coupled with knowledge interactions with public organizations. In Belarus, market-based interactions are less developed as mechanisms of inward knowledge transfer than in other European economies, while interactions between firms are to a large degree mediated by administrative mechanisms. The internal mechanisms of technology transfer and linkages are the State Science and Technology Programmes and the activities of the Republican Centre for Technology Transfer (RCTT). The RCTT was established in 2002 with the objective of increasing the proportion of technology commercialization funded from the budget. In addition, regional technology transfer centres have been established.

Table 21. Adoption of production technologies and inventions, by sector

	Organizations - users of transferred production technologies (sectoral shares, %)	Transferred and used production technologies (sectoral shares, %)	Inventions in transferred used production technologies (sectoral shares, %)
Machine-building and metal manufacturing	28.4	41.4	11.0
Food industry	14.9	9.1	2.1
Light industry	10.2	8.7	1.1
Chemical and petrochemical industry	3.4	8.2	13.7
Science and S&T services	13.3	6.3	33.4
Other industries	9.8	5.5	6.5
Fuel industry	0.5	4.8	0.3
Wood, wood processing and paper	8.2	4.5	0.2
Ferrous metallurgy	0.9	4.4	7.9
Building materials	5.9	3.0	8.4
Generation of electricity	0.5	2.1	-
Education	4.0	2.1	15.4

Source: SCST (2009), Science, innovation and technology in Belarus 2008, Minsk.

Inward technology transfer through linkages between enterprises is probably the most developed mechanism of technology transfer. Linkages are facilitated within state goals-oriented programmes with a consistent policy push towards commercialization. Linkages between large enterprises and SMEs are less developed.

FDI, R&D, subcontracting & trade: knowledge diffusion mechanisms

Belarus is a catching-up economy whose technological and innovation system operates behind the so-called "technology frontier". Its technology dynamics are strongly determined by the rate of absorption of new technologies and knowledge from abroad. Hence, the channels of acquisition of foreign technology and its absorption throughout the domestic economy should be key priorities for innovation policy. Adoption and dissemination of existing innovations (i.e. new to Belarus) rather than the development of "pure" innovations (i.e., new to the world) are critical for the development of the country. However, this does not always seem to be the case in policy practice, with innovation policy largely focused on domestic knowledge generation and the transfer of R&D results and innovation into commercial use.

As discussed in chapter 1, Belarus is quite an open economy in terms of trade intensity. However, compared to other East European countries, the inflows of foreign direct investment (FDI) have been more modest. Imported equipment and "learning by exporting" are therefore the most important mechanisms of technology transfer. At the same time, there is only limited learning through FDI and other mechanisms such as direct learning by the labour force working in foreign owned firms; learning of domestic suppliers and buyers from interactions with foreign firms; and learning through imitation, observation, demonstration effects and competitive pressures.

A significant trade dependence on CIS markets means that "learning by exporting" is from less demanding markets, and so learning effects are weaker. In the modern economy, learning and technological accumulation, which stem from integration in global supply chains and from FDI operating in the local economy, are increasingly indispensable. However, the mere presence of FDI is not in itself a guarantee that technological accumulation will take place. For this to occur, openness to FDI should be complemented by an associated policy of active technology acquisition.

Subcontracting represents an alternative channel of access to technology that could play an even greater role than FDI. Recent policies have made the integration of Belarusian enterprises into the network of multinational companies a possibility by facilitating access to knowledge, know-how, resources and markets by integrating Belarusian firms into international value chains and clusters.[69] Such policies are especially targeted towards sectors such as the chemical industry, machine building, microelectronics, banking and R&D proper.[70]

However, a gap remains between policy objectives and the instruments of integration into global production and technology networks. In particular, early experiences with the National Investment Agency have not been very encouraging. In addition, the integration and coordination of R&D and innovation policy with FDI and subcontracting policy could face numerous challenges in terms of the administrative capacity for implementing such policies, as well as in terms of the differing objectives that would need to be reconciled in attempting to coordinate these policies.

The issues of integration of upstream technological activities like R&D may seem less complex. However, due to the absence of strong links with the science and technology system of the EU, the international integration of the Belarusian science and technology networks is fairly limited. This is further compounded by a relatively low priority assigned to scientific and technological cooperation and R&D mobility and training and education abroad in the national innovation policy. For example, the Foundation for Basic Research has funds amounting to only $3.6 million for conferences, publishing activities and international cooperation, and yet it funds 90% of international cooperation in science in Belarus. Chapter 7 discusses further these questions.

[69] Methodology for the State Programme for Innovative Development for 2011-2015.
[70] http://www.subcontract.by/

4.3. Recommendations

Belarus has preserved engineering competencies in large enterprises, capabilities in the R&D sector and a skilled labour force. The country has also displayed a strong capacity for policy implementation. However, the concentration of R&D in research institutes and the marginal role of enterprises in this area are at odds with the experience of more developed countries. Such a situation is not conducive to strong innovation capabilities at the enterprise level.

Recommendation 4.1

There is a need to shift the strategic orientation of innovation policy from the focus on 'transfer of innovation from the R&D sector into production,' towards an 'enterprise-based innovation system'. This implies a gradual reintegration of R&D activities into the business enterprise sector. The restructuring of the R&D system should be voluntary, gradual, agreed with key stakeholders and facilitated by a public programme developed on the basis of pilot projects. Such a restructuring could be undertaken in three phases:

- *Diagnosis and development of a restructuring strategy for the R&D system which, after a thorough review, identifies two types of core activities: those that could be integrated into new organizations (including business enterprises, and those which could be phased out;*
- *Developing a restructuring plan. The objective of this step is to determine the dominant character of the new organization and how this could be achieved through the separation of core from non-core activities. This can result in a new production (service) enterprise, a public institute or an R&D enterprise/R&D centre; and*
- *Implementation of the new organizational blueprint on the basis of a detailed action plan, involving all stakeholders and carrying out the necessary disinvestment.*

Any reorganization of the R&D system should seek to create organizations with a coherent set of activities (commercial or public), that are viable in the medium term and can maintain and develop competencies in their core areas. The main direction of such reforms should be the integration of R&D activities into the business enterprise sector.

Recommendation 4.2

With a view to promoting the integration of R&D activities into the business enterprise sector and establishing organizations with a coherent set of activities the authorities could contemplate introducing policy measures and instruments that target:

- *Strengthening the linkages between universities and R&D institutes, and integrating basic research groups into universities;*
- *Encouraging the gradual reorientation of some R&D institutes towards serving the emerging sector of technology-intensive SMEs (in the manner of the German Fraunhofer institutes); and*
- *Facilitating labour mobility in the R&D sector, thereby reducing the costs of adjustment.*

The current R&D system is excessively oriented towards commercialization of R&D results to the point that it may undermine scientific excellence. Existing top-down coordination mechanisms for setting research priorities reduce the available space for scientific initiatives that deviate from these priorities. This approach may seem appropriate in the short term, but a policy that is excessively biased towards commercialization has negative implications for scientific excellence. While in the short and medium term it may be beneficial to integrate different types of R&D activities (basic, applied, development, engineering), this approach may also hinder research and innovation capacity in the longer-term.

Recommendation 4.3

The authorities could consider reforms in the system of public funding of R&D which would strive to balance commercial and scientific goals at research institutions and would seek to prevent commercialization pressures from eroding scientific excellence. To this effect they could consider measures that:

- *Differentiate between various types of R&D (basic research, applied research, development and engineering) in terms of objectives, programme design and incentives; and*
- *Diversify the system of R&D funding, including individual grants, projects and thematic programmes, to reflect both top-down guidance and demand generated by other innovation stakeholders.*

The current system of policy instruments in Belarus contains strong incentives for production and technical modernization but is weaker in the promotion of innovation proper. The public finance rules in state science and technology programmes apply uniformly to projects, many of which are modernization projects rather than innovation projects. Moreover, the rules strongly discourage risk taking, which results in perverse incentives that favour technically proven projects and thus reduce innovation ambitions. Innovation support has become intertwined with investment in modernization through a broad mixture of programmes funded through sectoral innovation funds.

Recommendation 4.4

In order to increase the effectiveness of the mechanisms and instruments of innovation support in Belarus:

- *Policies and instruments need to clearly separate support to innovation activities (where risk is an inherent component of the process), from support to investment in modernization;*
- *The entire mechanism of sectoral innovation funds needs to be re-examined; the rationale of maintaining such funds needs to be evaluated against international and domestic good practices;*
- *The effectiveness of the public support to innovation activities will be boosted by introducing a greater variety of diversified policy instruments drawing on international good practices (see recommendation 6.1); and*

- *In particular, new instruments need to be introduced that recognize that risk taking is an inherent feature of the innovation process (see recommendation 6.2).*

Belarus is a catching up economy that will remain dependent on imported technology for some time to come. One of the key factors for sustained and knowledge-driven economic growth is the efficient international technological integration and/or cooperation with leading foreign partners in innovation processes. Successfully addressing this issue will require economic liberalization and openness, the promotion of technological acquisition through trade, subcontracting and FDI, and facilitating the integration of domestic innovation stakeholders into global innovation chains.

Recommendation 4.5

To facilitate the cross-border technology transfer and inward diffusion of knowledge and innovation the authorities could consider focused policy measures and instruments that seek to:

- *Link incentives granted to FDI and/or inward subcontracting to innovation objectives, which could potentially increase technology spillovers with a positive innovation outcome;*
- *Encourage participation of Belarusian innovation stakeholders in global innovation chains;*
- *Enhance the innovation capabilities of SMEs and prepare them to establish long-term supplier relationships with medium-sized or large enterprises, both domestically and abroad (see recommendation 7.1); and*
- *Introduce policy measures encouraging strategic partnerships of this type that target innovation projects.*

Foreign direct investment, which has increased in recent years, has great potential to raise technological capabilities and facilitate the participation of Belarusian enterprises in the global networks through which knowledge is disseminated. Future FDI, including from neighbouring CIS countries, will depend on general factors such as improvements in the business environment and the strengthening of integration processes in the region. However, complementary policy measures will be necessary to attract science-intensive investment and ensure that the potential benefits of FDI are maximized.

Recommendation 4.6

The authorities could undertake a concerted effort to harness the potential of foreign direct investment to make a significant contribution in raising the innovation potential of the economy and provide access to new technologies and organizational practices. This could be achieved through policy actions such as:

- *The extension of the competencies of the National Investment Agency, which should also cover innovation-related and technological issues;*

- *The inclusion of technological considerations in privatization plans, as a strategic goal, in addition to revenue targets; and*
- *The clarification of intellectual property rights issues in R&D activities co-funded by the State to avoid any uncertainties that could discourage the involvement of investors.*

Chapter 5

INDUSTRY-SCIENCE LINKAGES AND COLLABORATION IN THE INNOVATION PROCESS

The aim of this chapter is to identify and analyze the existing mechanisms for interaction between public research institutions and enterprises and to assess how effective they are in transforming R&D into new products and technologies and bringing them to the market. The chapter analyzes the legal provisions and institutional mechanisms concerning technology transfer, including a discussion of the impact of existing intellectual property regulations. It examines the set of incentives embedded in different institutions, regulations and policies and their effects on encouraging successful collaboration. Finally, the chapter proposes some recommendations to facilitate technology transfer and strengthen the links between industry and science.

5.1 Industry-science linkages: policy issues and institutional actors

The description of the industry-science linkages (ISLs) policy agenda in Belarus starts with its positioning within the development of the national innovation system. It includes selected policy priorities and related incentive mechanisms. Based on the available programming documents,[71] the overall ambition can be identified as the integration of research and technological development (RTD) activities to foster innovation and generate knowledge intensive production. The integration efforts have been so far dominantly based on administrative allocation and coordination mechanisms. By contrast, incentive structures are underdeveloped, which reduces the dynamic efficiency of the innovation system. Therefore, some alternative incentive mechanisms have been considered to encourage innovation actors to cooperate closely and, ultimately, promote the commercial application of RTD outputs.[72] However, there are so far relatively few examples of such mechanisms. In any case, such arrangements have not been functioning for a sufficiently long period to bring effects that can be measured adequately.[73]

[71] The formative documents include the Concept of National Innovation System (2006)) and the Concept of the State Programme for Innovative Development (2011-2015). Priorities are elaborated on a sector specific basis, but also consider some horizontal issues concerning the development of the national innovation system, including barriers to be addressed to make the system more effective. See chapter 2 for further discussion.

[72] Examples of debates among the wider stakeholder community on innovation policy include presentations and discussions at the UNECE International Conference on Knowledge-based Development, 10-12 June 2009, Minsk, Republic of Belarus as well as at the 1st Belarusian Innovation Forum (17-18 November 2009).

[73] The examples include some special economic regime arrangements as technoparks, free economic zones, and university spin-offs. These arrangements encourage entrepreneurial spirit and innovativeness when developing new forms of cooperation or coordination, including more reliance on economic incentives. However, not sufficient attention appears to have been given to the qualitative evaluation of the functioning of these arrangements that would have facilitated improvements on the basis of past experiences. See also chapter 2.

Developing ISLs in the national innovation system as a policy priority

The programming documents on the national innovation system in Belarus do not address the ISLs agenda systematically. They focus instead on selected segments of the National Innovation System identified as ineffective or underdeveloped and propose administrative or legislative measures to overcome identified shortcomings. Formally, all the usual elements of the policy agenda supporting ISLs are present in the country (or at least accepted as desirable to be established or improved in the near future).[74] However, there is not yet a systematic and independent evaluation of their functional effectiveness.

More generally, strengthening ISL aims to facilitate and accelerate through various incentives the production and diffusion of knowledge and its application in the innovation process. As an example of such incentives, effectively protected intellectual property rights grant a temporary monopoly which increases the innovator's return on investment. In particular, closer science-industry linkages may be expected to boost high-tech production and (consequently) high value-added exports. A strong policy emphasis in Belarus is placed upon selected knowledge-intensive (science-based) technologies, in particular in connection with their capacity to substitute foreign supply to fulfil the needs of domestic industry (see chapter 3).

The priorities for ISLs include the reform of the existing structural-functional blocks of the NIS, formation and development of the innovation infrastructure, establishment of incentive mechanisms for innovation activity and development of the system for protection and exploitation of intellectual property rights. The challenges faced are partly related to the development stage of the national innovation system, being similar to those present in comparable, transition economies. At the same time, the country-specific model of economic coordination and incentive structures influences the range of effective instruments that can be adopted. Administrative and legislative measures may need to be complemented by other changes to address the challenges ahead.

Basic and long-term goal-oriented R&D (programming framework)

The aim of long-term goal-oriented R&D planning is to ensure the effectiveness of both state expenditures and the resources of co-financers (users of the project results), encompassing the whole innovation process from the creation of new knowledge to the production of knowledge-intensive products.

Research and technology activity is organized in accordance with 11 State Complex Target Research and Technology Programmes,[75] with the respective coordination councils,

[74] For their overview see OECD (2002), Benchmarking Industry-Science Relationships, OECD. Paris, which reflects the practice in developed countries at the end of 90s, which relied still on the concept of linear innovation to a significant extent. More recent developments, as presented in the OECD (2010), Innovation Strategy. Getting a head start on tomorrow, OECD. Paris, are based on a more sophisticated mixture of public-private partnership features.

[75] Horizontal coordination in the State complex programmes is difficult, as the individual stages of innovation process are institutionally (sectorally) separated. Much depends on the power or executive positions of individual stakeholders. The problem of coordination between the individual institutional sectors of NIS, participating in

combining state research programmes, state scientific and technical programmes and other programmes. These are integrated into the State Programme for Innovative Development of the Republic of Belarus, which defines a number of projects and the results of their implementation in terms of new enterprises and manufacturing departments, and the modernization of enterprises through the introduction of advanced technologies. For 2007-2010, the programme implementation envisages exploitation of about 1,300 technologies, of which 70% are based on domestic scientific development (see chapters 2 and 3 for a more complete discussion of the programming framework in Belarus).

Matching innovation supply and demand (NIS blocks)

The conceptual idea of NIS blocks is to integrate science, education and production activities – and thus develop industry-science linkages – to make them more knowledge-intensive (with respect to the quality of the R&D performed), and innovative (in terms of productive application of R&D results). On the supply side, the prominent role of applied science (defined as the active application of new knowledge) is stressed. Therefore, fundamental and applied research are expected to cater for the needs of economy and society, or, more specifically, to adequately reflect the nature of innovation demand as specified by the state customer (zakazchik). In this system, innovation supply and demand as well as the respective industry-science linkages are matched through administrative coordination and justified by multi-level expert evaluation of R&D and innovation priorities on which the subsequent project proposals are based.

Intramural R&D activities in the business sector or its demand for external R&D outputs financed with own resources (in the form of contracted research), are possible. However, the role of enterprises in both carrying out and financing R&D is limited. Nonetheless, as pointed out in chapter 4, in order to realize its objectives for general economic development (including a doubling of income per capita over the next five years), Belarus will need to increase the proportion of R&D funded and carried out by the business sector, which is the main R&D actor in most advanced economies.

The system of administrative coordination of innovation supply and demand specifies the obligations of producers and users of knowledge when the State provides financial support. When budget resources are involved, co-financing is required. A well developed administrative system of project submission and evaluation formally prioritizes practical applicability as a success criteria in applications for budget support. As the underlying NIS model is essentially linear (see chapter 1), the industry-science linkages that stem from this type of administrative coordination are also linear in nature.

As an alternative to administrative coordination between innovation supply and demand, some hybrid institutional arrangements were created to merge all the (linear) innovation stages under one roof, i.e. from knowledge creation through to the commercialization of R&D outputs (or even production and export activities). Besides the transformation of existing institutional arrangements, the establishment of new facilities would be required, focusing on

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the State complex programmes, is considered especially problematic when their knowledge intensities diverge markedly.

inter-sectoral issues and developing high-tech products. These would be based on a selection of major scientific organizations, design and engineering centres and pilot factories. A policy approach that is over-reliant on the traditional linear model of innovation was identified as a weakness in chapter 4. Such hybrid institutional arrangements could also give rise to new types of industry-science linkages that are more effective in the broader innovation system.

Research centres under the National Academy of Sciences of Belarus are prominent examples of initiatives to accelerate the creation and production of innovative products (application of innovation). Their extended functions (in sharp contrast with the traditional roles of the Academies of Sciences, which tend to be focused on basic research), include research and production centres, scientific centres and production associations. Researchers are required to pay adequate attention to the practical exploitation of their products.[76] The widening of the NASB's role towards the application of knowledge encompasses scientific, technical and technological processes as if they were within the framework of one company. Most research institutes have the infrastructure to run experimental production projects to test innovations and produce goods for sale.

Within the university sector, the examples of external knowledge activities include cooperation with domestic and foreign contractors (users of knowledge), through to the production and export stages of the innovation cycle, as is the case with the National Academy of Sciences of Belarus.[77] Universities may include small and medium-sized enterprises specializing in knowledge-intensive production (based on university R&D activities). Universities build up the necessary innovation infrastructure or participate in its development, including science parks, innovation centres, technology transfer centres, information-marketing centres and centres for the support of innovative entrepreneurship (see chapters 2 and 3). Technology transfer, as the favoured form of ISL within the university sector, is to be performed mainly through two mechanisms – either on an institutional basis with the contracted enterprises (for technological development or intellectual property rights), or on an individual basis through mobility schemes for university researchers, participation in joint projects and expert and diffusion activities.[78]

Some policy measures also target industry-science integration within the business enterprise sector through the creation of large entities (such as clusters or holdings), capable of becoming internationally competitive players in knowledge-intensive industries.[79] The large business structures (holdings or concerns) are expected to attract small and medium-sized enterprises and other supporting activities and organizations (such as education, consulting and technical infrastructure services), to develop tightly linked technology-based production chains, mostly independent from external supplies. The ambition is to build up vertically integrated and strongly specialized structures overcoming the deficiencies of the current administratively coordinated industry-science collaboration.

[76] M. Myasnikovich (2010), Science and Innovation Underpin Belarus' Long-Term Competitiveness, Economy of Belarus, 1/2010.
[77] V. Khrustalyo (2000), BNTU: Advanced Ideas, Advanced Solutions, Economy of Belarus, 4/2009.
[78] The extent of external cooperation of the state (technical) universities is large in terms of the reported projects and partners; however, the financial contribution to the institutional budgets is limited.
[79] Concept of the State Programme for Innovative Development of the Republic of Belarus for 2010-2015.

5.2 Intellectual property rights and industry-science linkages

Intellectual property agenda (IP) issues are given particular attention in a number of policy documents as the effective application of IPRs is considered as a (potential) supplementary source of income with a positive incentive effect for innovation. In addition, the commercialization and enforcement of IPRs also acts as a mechanism for developing industry-science linkages within the NIS.

Besides legal reforms, which are to some extent inspired by foreign experiences on the allocation of property rights, new initiatives aim to provide IP management support to enterprises, which should set up special units with IPR experts (i.e., with at least one specialist with good knowledge of copyright and IPRs). At the industry level, a specific agency is to develop and enforce patent and licensing policy, provide data analysis, supervise the transfer of rights for industrial facilities and carry out patent research to devise a successful marketing strategy on domestic and foreign markets.[80]

Belarus is party to 17 international treaties administered by the World Intellectual Property Organization (WIPO) (see also box 9). These include, among others, the Paris Convention (industrial property), the Patent Cooperation Treaty, the Bern Convention (copyright), the WIPO Copyright Treaty, the Rome Convention (related rights), the WIPO Performances and Phonograms Treaty and the Madrid Agreement (international registration of marks).

The national legislation on intellectual property includes normative and legal acts elaborated in cooperation with WIPO and takes into account international standards, including TRIPS (Trade-Related Aspects of Intellectual Property Rights) requirements. It comprises the Civil Code of Belarus, which identifies the objects of intellectual property rights (article 980), but also special laws including the Law on Copyright and Related Rights (as amended, 1998); the Law on Patents for Inventions, Utility Models and Industrial Designs (as amended, 2004); the Law on Trademarks and Service Marks (as amended in 2000 and 2006); the Law on Geographical Identification (as amended, 2004); the Law on Patents on Plant Varieties (as amended, 2004); and the Law on the Legal Protection of Integrated Circuit Topography (as amended, 2004). Finally, the Criminal Code and the Code on Administrative Violations provide for criminal and administrative penalties to be applied in cases of infringement of patents, copyright and related rights.

Material authors' rights regarding works of science, literature and art are granted for the lifetime of the author and 50 years following the author's death. Invention patents are valid for 20 years with a possible five-year extension. Trademarks are granted for ten years with the possibility of repeated extensions of ten years each. Renewable utility models are granted for five years with a possible extension for three more years, while industrial design patents are granted for ten years with a possible extension of five years. If the patent holder so requires, violation of the exclusive rights is to be desisted and the violator is obliged to compensate the patent holder for the losses incurred according to the legislation.

[80] State Programme for the Protection of Intellectual Property 2008-2010; National Center of Intellectual Property, Annual Report, 2009.

Figure 11. System of protection and management of intellectual property

<table>
<tr><td colspan="4">Council of Ministers of the Republic of Belarus</td></tr>
<tr><td colspan="4">Commission to protect and combat violations of intellectual property rights</td></tr>
<tr><td colspan="2">State Committee on Science and Technology</td><td colspan="2">Judicial Board on Intellectual Property</td></tr>
<tr><td>Patent Fund</td><td colspan="2">National Centre of Intellectual Property</td><td>Association of Patent Attorneys</td></tr>
<tr><td colspan="2">Industry Services for Intellectual Property Management</td><td>Regional Consultative-Methodological Centres</td><td>Institute of Intellectual Property Appraisers</td></tr>
<tr><td colspan="2">Legal persons</td><td>Physical persons</td><td>Foreign persons</td></tr>
</table>

Source: Presentation by E. Sesitski at the UNECE International Conference on Knowledge-based Development, 10-12 June 2009, Minsk, Republic of Belarus.

The implementation of government policy (figure 11) in the field of intellectual property is the responsibility of the State Committee on Science and Technology. Subordinated to the Committee, the National Intellectual Property Centre (NIPC) functions as the national intellectual property office in charge of registering patent and licence agreements, concession agreements and other agreements in the area of intellectual property. Technology transfer contracts are not subjected to screening and the only requirement is to register licence agreements. The NIPC Appeals Board is also involved in the pre-court settlement of any intellectual property-related disputes, while judicial settlement is carried out by the Judicial Board for Intellectual Property Issues of the Supreme Court. The State Commission on Intellectual Property Rights Protection and Intellectual Property Violation Control under the Council of Ministers is the coordination body that ensures the cooperation of all ministries and other state agencies in the area of intellectual property protection and enforcement.

The priority directions for the development of the national intellectual property system, including mechanisms to address existing challenges are outlined in the State Programme of Intellectual Property Protection for 2008- 2010 (Decision of the Council of Ministers No. 1555/2007). The aims of the programme are the promotion of innovation through the creation and exploitation of intellectual property rights, enhancing the efficiency of industries through effective intellectual property management, modernizing intellectual property protection and management infrastructures at the industry and regional levels including the development of appropriate government monitoring and supervision, developing information and methodological support services of intellectual property protection and management, expanding the range of the services, developing intellectual property education and training, as well as preventing and combating intellectual property infringements.

More specifically, the NIPC training activities seek to raise awareness of the importance of intellectual property protection and commercialization within the country and contribute to improving the knowledge of Belarusian managers and business representatives of commercial intellectual property questions. An intellectual property training centre was set up within the NIPC with the assistance of WIPO in 2004 to address this issue.

5.3 Technology transfer and commercialization

Technology transfer in Belarus includes the process of commercialization of intellectual products and R&D results, exploitation of intellectual property rights through the development of new technologies and participation in cooperative R&D projects. The process of technology transfer essentially implies the establishment of new, or the development and strengthening of existing industry-science linkages.

At present, more than 50 legislative acts and norms in Belarus deal with technology transfer, in particular the financing of R&D results from the state budget, transfer of technology developed with budgetary funds to state organizations and companies as well as to the organizations with mixed ownership and to small businesses, dissemination of information related to technology transfer, creation of institutions responsible for IP-related issues, ownership of inventions and remuneration for their exploitation.[81]

The acquisition and exploitation of intellectual property rights related to research, technology and development results financed partially or fully with state budget resources are regulated by the Presidential Decree No. 432/2009, according to which they are assigned to the Republic of Belarus or the relevant administrative-territorial entity (represented by the related state customer and/or state contractor). The disposal of property rights resulting from RTD results includes their full or partial transfer to third parties or the transfer of rights to exploit these results.

The state customer, as the owner of property rights to RTD results, is allowed to transfer them and provide the right to exploit them free of charge to state authorities and organizations, to the organizations subordinated to the state customer, to a non-state contractor or other organization (individual entrepreneur) participating in the financing of RTD results (with minimum 50% of total costs), to the innovation infrastructure entities (excluding venture organizations) and small innovation enterprises. The transfer of property rights is conditional on a government approval in cases where expenditure on the RTD results exceeds a certain threshold. The contractor or other state organization disposing property rights on RTD results are allowed to transfer them free of charge to non-state organizations (including foreign entities), only when given approval by the state customer. While there is a significant flexibility and a wide range of options available, its effective use remains limited in practice, partly due to the existence of cumbersome administrative procedures.

[81] The technology transfer and commercialization agenda is closely linked to intellectual property legislation and regulation. A number of publications of the Republican centre for technology transfer cover these problems, in particular regarding the implications of the current incentive structures: D.M Viltovskii, E.P. Mashonskaya and A.A. Uspenskii (2010), Policy and legislation in the field of technology transfer: foreign and domestic experiences, Kovcheg, Minsk.

The supporting infrastructure within the field of technology transfer is represented prominently by the Republican Centre for Technology Transfer (RCTT), founded in May 2003 under the auspices of the State Committee on Science and Technology of the Republic of Belarus, the National Academy of Sciences of Belarus, the United Nations Development Programme (UNDP) and the United Nations Industrial Development Organization (UNIDO).

The RCTT is tasked with promoting cooperation between the developers and users of high technologies and potential investors. The main tasks include forming and maintaining information databases to serve clients in the technology transfer sector; providing the RCTT's clients with access to the UNIDO network and other international databases dedicated to technology transfer, research and development; assisting innovation activity agents in development and promotion of their innovation and investment projects; instructing and training specialists in research- and innovation-related entrepreneurship; establishing RCTT regional innovation offices in the country, with the aim of creating a unified national network of technology transfer centres; and assisting and promoting international research and development cooperation and exchange of specialists. The RCTT structure (linked through an IT network) includes five regional departments and 26 affiliated extension offices at R&D organizations, universities and companies.[82]

5.4. Public procurement

Public procurement can also act as an instrument for promoting industry-science linkages but such mechanisms have not been extensively applied in Belarus to date.

The applicable general legislation on public procurement includes the Regulation on Supplies of Goods for State Needs (Presidential Decree No. 618/2008), which defines competitive bidding as the default procurement method. However, some of the largest contracts can be and sometimes are placed directly. In some cases, the enterprises bidding for contracts are controlled by the ministry placing the contract. Much of the procurement of standard goods and services is channeled through a limited number of state enterprises. An overall, comprehensive law on public procurement has yet to be introduced, and the actual procurement process is governed by a number of decrees and resolutions.[83]

There is no central body charged with collecting and publishing consistent and complete information concerning public procurement, and acting as an independent referee in the case of complaints by unsuccessful bidders. The Ministry of Economy has responsibility for general policy on public procurement, developing procurement related regulations and collecting data and statistics on contract awards, while the Ministry of Architecture and Construction is responsible for building and civil engineering contracts, including control of the prices of inputs. For the most part, procurement is centralized and ministries (and their

[82] A new public initiative on the creation of an IP exchange, which is being supported by the creation of a knowledge network, seeks to make a further contribution to the development of an infrastructure for technology transfer.

[83] The system of public procurement is made complicated by the complexity of the related legislation combined with the interventions of the individual authorities. World Bank (2009), Belarus - Public expenditure and financial accountability (PEFA): public financial management assessment, Washington D.C, World Bank.

counterparts at the regional and local levels), are required to procure many types of goods through public enterprises such as Belresources, which acts as a purchaser and monopoly supplier.

5.5. Public-private cooperation

Public-private cooperation in the Belarusian NIS is constrained by the still limited role of the private sector in economic activity. Partnerships are supported through indirect (fiscal) measures, such as tax allowances for companies performing RTD activities or implementing their results, or for banks providing long-term credits for innovation projects. Institutional structures conducive to public-private partnerships include free economic zones, sci-tech parks (more specifically, the High-Tech Park) and technology transfer centres (see chapters 2 and 3). Supporting (networking) structures include professional associations such as the Chamber of Commerce and Industry, the Confederation of Industrialists and Entrepreneurs (Employers) and the Association of Industrialists and Entrepreneurs.

The Free Economic Zones (FEZ) were set up to support the development of private sector enterprise and investment in Belarus by means of preferential treatment and incentives to registered members, including both local entrepreneurs and foreign investors. The incentive package includes tax holidays on all goods and services produced in the FEZ for a period of five years, followed by a 50% reduction in profit taxes and VAT on import substitution goods manufactured within a FEZ; no taxes on real estate owned or leased in the FEZ, exemption from payments to the National Agriculture Support Fund, no tax on purchasing vehicles, no customs duty on raw materials and imported equipment and a guarantee that relevant legislation will not change for seven years. Each FEZ provides administrative support to its members and, in all, joining an FEZ confers an estimated 40% reduction in tax burden compared to non-membership. The first FEZ was set up in 1996 in Brest, and now six zones are located around the country (Minsk, Gomel, Vitebsk, Grodno, and Mogilev). Like the High Technology Park, (see chapter 3), the FEZs represent innovation support institutions favoured by specific, supportive framework conditions (both fiscal and regulatory), that could be applied more generally to boost innovative development.

5.6 Assessment

The evaluation of the situation regarding ISLs is based on the analysis of the available official documents produced at the national level and the consultations with representatives of the authorities with responsibility for these issues.

ISL issues are given significant attention in policy and programming documents in Belarus, which have resulted in the creation of specific institutions. However, there is not yet a systematic evaluation of the results or effectiveness of these links. The available information, predominantly on the legislative and regulatory aspects of individual ISLs segments (their functional and organizational deficiencies and proposed remedies), is mostly of a descriptive nature. The regulatory framework is somewhat fragmented, thus creating additional difficulties for evaluation.

A systematic evaluation would therefore require extensive and independently-conducted field enquiry (mostly qualitative), involving the key ISLs agents (including intermediating structures), and their interfaces and inward and outward extensions. More specifically, data on intersectoral financial flows of RTD expenditure are not available or their information value is limited due to differences with the standards laid out in the so-called Frascati manual (see chapter 1).

ISLs barriers and development priorities

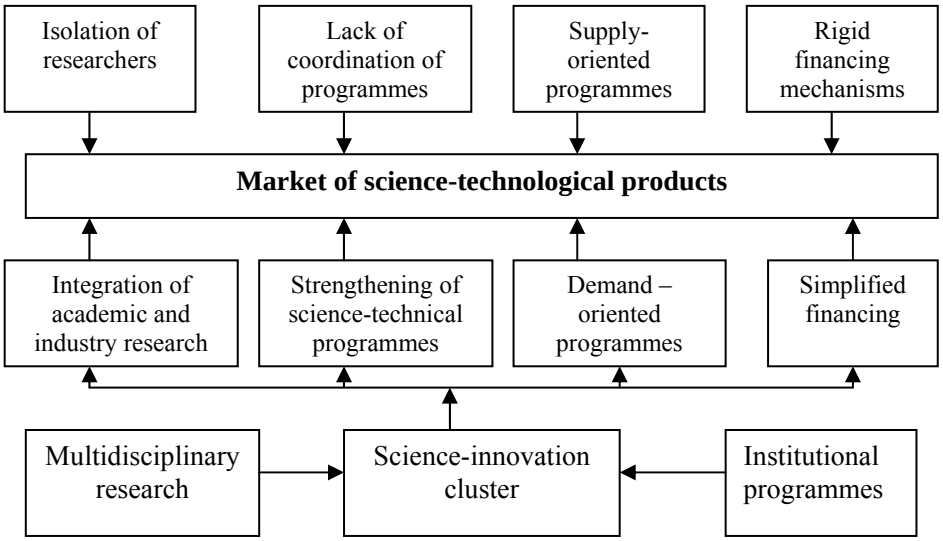
The most important barriers for the development of industry-science linkages in the national innovation system of Belarus were summarized in the 2006 *Concept of the national innovation system*. These included the low level of domestic demand for innovation, especially for the exploitation and use of science and technology results, even when they are considered as commercially viable, due to the underdeveloped market for innovative products and relatively low levels of innovation activity in the business sector. The resulting mismatch between innovation supply and demand means that collaboration between knowledge producers (R&D institutes and universities) and users (industry) often seems unattractive given the disparities regarding knowledge intensity and field/industry specialization.

The lack of commercialization capacity, which results from the absence of a functioning market for science-technology production, makes collaboration between science and industry difficult, as economic incentives are weak. The administrative coordination mechanism is not sufficient to match supply and demand for innovation.

The priorities in the development of structures and mechanisms to promote industry-science relationships included the reform of the existing structural-functional blocks of the NIS, developing the innovation infrastructure, creating incentive mechanisms for innovation activity, and developing the system for exploitation and protection of intellectual property rights. Although a number of activities have been undertaken to support the formulated priorities, particularly through creation of the related legislation and administration framework, no evaluation is yet available regarding the effects of the new or reformed ISL structures and mechanisms.

Based on the priorities formulated in the Concept for the Programme of Innovative Development for 2010-2015, new organizational structures (or the extension/intensification of existing ones) were proposed. The aim is to ensure the match of innovation supply and demand while including all stages of the innovation process. The collaborative links between the academic and enterprise segments of the NIS are to be strengthened through the support of corporate structures and scientific-technological (practical) centres (clusters, corporations, financial-industrial groups/holdings). The programme also envisages stimulating demand for R&D results in industry, although concrete measures are not specified. The scientific-technological linkages between technology users and producers are being targeted as a way of making the innovation infrastructure more effective in terms of technological diffusion and related services. Intellectual property rights will be used to create more effective economic incentives for innovation. Figure 12 presents the schematic overview of factors affecting the market for high technologies, which has influenced the formulation of these new priorities.

Figure 12. Factors affecting the market for high technologies



Source: Presentation by A. Markov at the UNECE International Conference on Knowledge-based Development, 10-12 June 2009, Minsk, Republic of Belarus.

Most of the ISL priorities formulated in 2010 repeat or only slightly modify the preceding 2006 Concept, which suggests that the functional deficiencies identified and analyzed above still persist in spite of the reported policy and organizational efforts. These deficiencies have also been extensively reflected in analytical contributions, especially regarding the role of intellectual property rights in the incentive structures of both technology creation and technology transfer.

IPRs and technology transfer

The use of IPRs can be improved by developing existing expertise and supporting infrastructure. However, the distribution of the income generated from the commercialization of IPRs is the primary incentive for patenting innovation results. To date, the exclusive owner of government funded R&D results is generally the State, i.e. the inventors and their employing organizations do not receive the legal IPRs. This arrangement is frequently criticized, as the individual and institutional economic incentives for the commercialization of R&D results are weak under such arrangements.

According to the Presidential Decree No. 432/2009, the rights of the inventor are specified by an agreement. However, the protection offered does not create strong innovation incentives. The technology developed with the support of state budget resources can be transferred free of charge only to state enterprises. Private enterprises or enterprises of mixed ownership would have to pay for the cost of the technology development.

The lack of strong incentives for commercialization in IPR arrangements creates challenges for the increase of innovation activity by both knowledge producers and users. The emphasis

on administrative mechanisms assigns insufficient attention to the system of incentives, which results in a weak internal dynamism. Even in countries with an active governmental role in technology-intensive economic development (as in the countries of South-East Asia), the entrepreneurial elements were present and supported in R&D activities, stimulating individual initiative for the commercialization of knowledge outputs (see chapter 2 for a discussion on the weakness of the entrepreneurial element on the National Innovation System).

Without effective market stimuli to complement the strong regulatory role of government, the internal (self-sustaining) innovation dynamics are limited. Despite the reported administrative and policy efforts, the available indicators on technology transfer and commercialization effects show mixed results (see chapters 1 and 4).

Public-private cooperation

The development of public-private cooperation in Belarus has been constrained by the de facto weak position of the small and medium-sized business sector vis-à-vis the large state owned enterprises and state organizations in general. SMEs also have a still very limited (though gradually increasing) share in the national economy. Their role in innovative development is constrained by a number of factors including low levels of awareness; limited knowledge and capital intensity of the activities in which they specialize; and not least by their poor linkages to other agents in the NIS, including R&D institutions and large enterprises. Limited access to financial resources therefore restricts the growth potential of innovation activities. Administrative and cultural barriers make cooperation (including the creation of more sophisticated supply chains), between large companies and SMEs difficult. The private sector often prefers not to get involved in partnerships with state bodies to avoid additional administrative and regulatory burdens upon their activities (see also chapter 4).

The National Business Platform, updated annually since 2006, reflects business community proposals to improve Belarusian business climate. Not all suggestions have led to regulatory reform, but the initiative has been relatively successful, with around 150 changes implemented. Among the six priorities for economic reform raised in 2010, public-private cooperation issues were mentioned extensively, starting with the requirement for equal access to resources for state and private businesses, and ending discrimination against private property in all market segments, including public procurement, asset management, payments, auctions and tenders. More specifically, a legal definition of innovative business and the entities engaging in it is proposed, including incentive schemes for innovative activities and support for the development of a network of innovative small businesses at universities and academic institutions, and partnerships between public and private companies.

The formation of a legal framework for public-private cooperation has recently been initiated in Belarus. The elaboration of the law on public-private partnership and practical implementation of its principles through state participation in infrastructure and investment projects started in 2010 under the auspices of the Ministry of Economy (in cooperation with the Central Bank). The parameters of the respective legislation in Belarus are currently under discussion, and therefore the evaluation of their potential impacts is not yet possible. Although international experience can provide useful guidance, the underdevelopment of the private sector and the dominance of state institutions are particular constraints.

5.7 Recommendations

Policy documents and regulations concerning the relations between industry and science in Belarus tend to emphasize legal and administrative aspects of their interactions and address only to a lesser extent the incentives of innovation stakeholders to engage in innovation projects. In accordance with the contemporary understanding of the nature of the innovation process, one of the key responsibilities of public policy is to set rules and institutional frameworks that both reflect the public interest and provide the right incentive structure. Therefore, policy efficiency to spur innovation activity could be raised by introducing economic mechanisms to encourage the commercial exploitation of R&D results. Administrative guidance or compulsion cannot fully replace economic incentives to ensure the dynamism of the innovation system. The knowledge creators should be able to profit from their innovation efforts, as this produces the necessary incentives to promote commercialization. In turn, public research organizations also need to develop internal rules that promote the commercialization of their outputs and upgrade their competencies to deal with these matters.

Recommendation 5.1

R&D performing organizations and inventors should be assigned clearly defined property rights, in particular, intellectual property rights associated with their own research and innovation activity. To this effect the authorities could:

- *Consider granting autonomy to research institutions with respect to intellectual property rights, including the practice of allocating intellectual property rights to the performing research organization while ensuring that individual researchers or research teams can share in the rewards (royalties);*
- *Develop and put in place guidelines for R&D performing organizations regarding their internal intellectual property policies, including the sharing of financial returns, the ownership of research results, conflicts of interest and engagement with third parties;*
- *Support IPR training of researchers and staff involved in the commercialization of intellectual property rights in R&D performing organizations; and*
- *Support the development of intermediaries (innovation brokers) that facilitate IPR-based linkages between industry and science.*

Some types of R&D activities in Belarus seem to be disconnected from the needs of industry; so also are the rewards for such research. This situation partly stems from the established practice of setting agendas and plans for research institutions that are not always linked to industry demand, and is therefore not conducive to closer collaboration with the industry. Continued and consistent policy efforts are required to ensure a better connection between the two subsystems.

Recommendation 5.2

In order to reinforce internal incentives for the commercialization of R&D, the authorities could consider:

- *Establishing policy mechanisms that stimulate direct channelling of industry R&D demand into the work plans of R&D institutions, without necessarily passing through state S&T programmes, and allocating public funds in support of such R&D activities;*
- *Introducing evaluation criteria for publicly-funded research that takes into account the linkages between excellence in research and its application in industry; and*
- *Introducing science-industry IP and knowledge transfer components in appraisal procedures, both in screening R&D projects and in rewarding the academic participants in such projects.*

Technology transfer is a complex matter that requires the creation of dedicated support institutions and a system of incentives that encourages the involvement of academic staff in the commercialization of research outputs. Technology transfer activities may be a source of revenues for research institutions, but this should not be the primary concern and needs to be balanced against other objectives. The authorities can provide a wider range of support measures that facilitate the efforts of research institutions.

Recommendation 5.3

The process in technology transfer in Belarus could be intensified by:

- *Introducing economic incentives to encourage and reward entrepreneurship and entrepreneurial behaviour within the academic community;*
- *Introducing new forms of knowledge and technology transfer from public research organizations to the business sector such as public/private partnerships to fund R&D efforts, specific incentives for cooperation with business and support for spin-off formation; and*
- *Expanding the scope of professional technology transfer services (legal, financial, commercial) and developing model contracts and related decision-making support tools to assist R&D organizations in technology transfer.*

New technology-based firms play a key role in linking science and industry, as they are nimble, ready to explore possibilities in a flexible way and provide opportunities for entrepreneurial initiatives originating in the academic and research world. There is wide scope for promoting the emergence of such firms in Belarus and stimulating their growth and integration in the economy.

Recommendation 5.4

To stimulate the emergence and growth of new technology-based firms the authorities could consider the following policy steps:

- *Undertake a critical assessment of the existing barriers to the emergence of new technology-based firms (in particular, academic spin-offs) and to the growth of existing ones;*
- *On this basis, design targeted policy measures to improve economic conditions for the development of new technology-based companies, taking into account the proposals made by the business sector; and*
- *Introduce instruments for targeted support for innovative start-ups to facilitate their growth and integration in the economy.*

Chapter 6

FINANCING OF INNOVATIVE ENTREPRENEURS

This chapter discusses the sources of finance for innovative activities in Belarus. It provides a description of the financial sector in Belarus, paying attention to the development of various financial intermediaries and the capital markets. It considers various sources of finance linked to state programmes and a number of specific support structures. Finally, it presents some policy conclusions and recommendations for further development of the financing of innovation in Belarus.

6.1 Access to finance and financial sector development in Belarus

The financing of innovation is an important focus in the design of innovation and technology policies in all countries. At a general level, the financial system is a key driver of economic growth. Innovation and export activity – major drivers of development in catching-up economies like Belarus – are both affected by the quality of the financial system and the corresponding capacity to sufficiently finance these activities.

More specifically, the financing of innovation presents particular challenges and the need for public support is well understood. Innovation has some attributes that reduce the willingness of external investors to provide financial resources (information asymmetry, moral hazard, high risk), and may therefore create a tendency to invest in innovation by the private sector below what would be socially desirable.

Independent of the level of development of the financial system, most countries have established innovation financing support instruments that seek to compensate for the shortcomings of both bank- and equity-based financial systems when financing innovation. Different forms of public financial support (e.g. soft loans, grants and guarantee schemes, encouragement to business angels and venture capital activity) have been devised to mitigate the tendency to under invest in innovation. In Belarus, the strong presence of the State in the economy, the extensive use of administrative and coordinating mechanisms and the underdevelopment of the private sector create a particular context for the financing of innovation.

The level of development of the financial system is of great importance for economic growth and innovation. Financial systems and production structures co-evolve and thus interact in many different ways. International experience indicates that countries with better functioning financial systems do grow faster as the financial system eases external financing constraints that impede firm and industrial expansion. This is particularly important in the innovation context. Sectors that need more R&D investment do grow faster in countries with well developed financial systems.

Insufficient access to external finance as a result of the underdevelopment of the financial system not only hampers innovation but also creates difficulties for export activities. This is particularly important for countries in the catching up phase, like Belarus, as the most important issue is supporting investment into up-to-date production equipment that allows full use to be made of labour cost advantages.

The level of financial intermediation has increased rapidly in recent years in Belarus, with strong growth in credit to both enterprises and households, albeit starting from a low level. The credit to GDP ratio rose from around 25% in 2006 to 45% in 2009. However, this is still rather low compared with other Central and Eastern European countries.[84] Despite the crisis, total loans rose by 46.5% in 2009, as a result of lending under state programmes. The reported level of non-performing loans remains low, at around 4%.

The Belarusian banking sector is highly concentrated and dominated by state-owned institutions, which hold around three quarters of total banking assets. Out of the 32 banks active on the Belarusian market, the largest five banks account for 85% of total banking assets. Three out of the five largest banks are state owned.

The high level of lending related to some form of administrative regulation has played an important role in promoting macroeconomic stability,[85] notably during the 2008-2009 financial crisis, but has also crowded out market-based lending.[86] The total amount of such loans was 31.7 trillion Belarusian roubles and amounted to 49.8% of total loans in the Belarus banking sector at the end of 2009.[87] The creation of a special financial agency (SFA) was discussed as part of the 2009 IMF stand-by programme. This agency would take the existing stock of loans under government programmes and provide future financing under these schemes. This initiative would relieve banks from the burden of financing government programmes, thus increasing their commercial orientation and facilitating privatization (see also chapter 1).

While there has been marked progress in other areas of the business environment as surveyed in the World Bank Doing Business Report, access to credit remains problematic. In the 2010 report, the country was ranked 113, well below most other countries in the CIS. However, this is a partial indicator that covers only a limited number of issues, including the strength of legal rights and the availability of information on creditors. The indicator on legal rights considers the extent to which assets can be used as collateral and the rights of creditors. There are strong limitations regarding the use of collateral in Belarus. This may be of less relevance to small innovative companies that have little collateral to offer, but it is nevertheless indicative of the difficulties in obtaining credit. The Annual Report of the National Intellectual Property Centre shows that intellectual property, which appears more relevant for this type of company, is not used as collateral.

[84] Raiffeisen Research (2010), Gradually gaining momentum – and leaving the storm behind, CEE Banking Sector Report, Vienna.
[85] EBRD (2009), Belarus, Transition Report 2009, London.
[86] IMF (2010), Republic of Belarus. Fourth Review Under the Stand-By Arrangement, Washington.
[87] BNP Paribas, Deutsche Bank, The Royal Bank of Scotland, Sberbank, Belarusbank (2010), Prospectus for the U.S.$ 600,000,000 Bond Issue of the Republic of Belarus.

At the same time, there is evidence suggesting that access to finance is not a critical constraint in comparison to other factors. According to the World Bank/EBRD 2008 Environment and Enterprise Performance Survey, access to finance was considered a major obstacle to development by around 10% of firms, below taxes and the level of human capital. However, this survey does not reflect the position of small or new innovative firms that are likely to find themselves at a financial disadvantage.

Other segments of the financial market are less developed and therefore provide limited alternatives to banking financing. The Belarusian Stock Exchange trades mostly government bonds in Belarusian or foreign currency which can be held by legal entities and individuals, by residents and non-residents. The nominal outstanding amount of long-term government bonds was $714.3 million at the end of 2009. The number of equity or debt issuances by Belarusian companies remains relatively small. The market capitalization of companies listed on the Belarusian Stock Exchange was 3.2% of GDP at the end of 2009. The total outstanding nominal amount of corporate bonds represented 6% of GDP. The European average market capitalization stood at around 60% of GDP in 2008.

Despite the progress observed in recent years, it is clear that there remains significant scope for the development of the financial system in Belarus, including further growth of the banking sector and capital market-based instruments. Expanding the options for financing would contribute to the dynamism of the economy and facilitate innovation, as new arrangements by companies to take on and diversify risks would be possible.

SME financing

SMEs are essential to ensure economic dynamism. They are nimbler than large established companies, and readier to explore commercial opportunities in a flexible way. However, SMEs are prone to having insufficient access to external financial resources in all countries due to the risk aversion of banks and a lack of collateral. Thus, financial frictions are particularly detrimental for small or young firms and firms in the service sector. Non-banking forms of finance, such as business angel or venture capital are often limited. These are very important for the most innovative and promising projects, but cannot substitute for other financing instruments and mechanisms of support, whose absence affects all innovative companies.

Access to finance by SMEs remains problematic in Belarus, in particular outside Minsk and the large regional centres. This partly reflects not only the relatively low level of development of the financial system in Belarus, but also deficiencies in the capacity of enterprises to deal with banks. Some estimates suggest that around two thirds of SMEs in Belarus have no access to bank credits. Individual entrepreneurs, in particular, face a very high cost of finance. By the end of 2009, interest rates on loans in roubles for individual entrepreneurs were twice those charged on average by commercial banks.

There have been a number of programmes for micro-lending and lending to SMEs, sometimes with the support of international organizations. The Belarusian Bank for Small Business was founded in 2007 by the EBRD and some other international public and private financial organizations. The Bank has a capital of $9.6 million and focuses on small loans. While the

bank has been operating mainly in Minsk and its region, there are plans for expansion to other parts of the country.

The Belarusian Fund for Support of Entrepreneurship provides guarantees for soft loans extended by banks to small business. Typically, guarantees do not exceed 70% of the value of the loan and are provided for up to three years. Investment projects are selected on a competitive basis. Priority is given to enterprises that seek to develop and expand the production of export-oriented, import-substituting or energy saving products or such seeking to implement new technologies. Resources for the activities of the fund are provided directly through the budget, in line with the Programme for State Support of Small Enterprises (Presidential Decree No. 255 of 21 May 2009). In 2010, the amount earmarked for this purpose was 327.6 million Belarusian roubles (see also chapter 2).

6.2 Financing innovation in the context of state programmes

Most decisions on financing innovation in Belarus are taken in the context of a significant state presence in the economy. Many enterprises, especially the large ones, are part of the state-driven system of programming, implementation and evaluation. By contrast, the private sector plays an increasing but still modest part in Belarusian innovation activities. Thus, the State can significantly influence the decisions of the most important actors in the national innovation system.

The programming activities (see box 2 in chapter 2) are similar to those of a large diversified conglomerate that has to balance horizontal (between different topics and institutions), sectoral and regional demands while at the same time pursuing top-down priorities and remaining responsive to bottom-up proposals.

Box 6. Financing the State Programme for Innovative Development of Belarus, 2007-2010

Only a fraction of the overall costs of the envisaged innovation activities (40.9%) is financed out of the state budget. The remaining resources come from local budgets (0.3%), bank credits and loans (34.0%) and the resources of the participating institutions (24.9%). The financing structure of the concerns (conglomerates of enterprises) deviates somewhat from the overall average figures: the share of state budget financing (51.9%) is 11 points higher than the average, while the contribution of loans (23.9%) and the concerns' own resources (19.4%) are correspondingly lower (see table 22).

The largest share of resources in the 2007-2010 State Programme for Innovative Development is allocated to the Bellesbumprom concern (33%), aiming to modernize lumber processing. The Belneftekhim concern, which organizes the chemical and petrochemical branches, accounts for 12% of these funds. The Ministry of Industry, which oversees mechanical engineering, optical and electronic instrument engineering, microelectronics, radio electronics, metallurgy and welding, production of communication facilities, and software development, receives 10.7% of these innovation resources. This share is roughly similar to that of the Ministry of Construction and Architecture, which is involved in construction, reduction of material and energy consumption, and recycling.

Table 22. Organizations in the State Programme for Innovative Development, 2007-2010

	Funding, Belarusian rouble billions (BYR bn.)						
		by funding source					
State organization	**Total**	**National budget** [i]	**Local budget**	**Bank credits**	**Loans**	**Internal funds**	**% of total**
Ministry of Industry	**651.5**	0.4	1.0	496.6	-	153.6	10.7
Ministry of Construction & Architecture	**653.0**	3.0	-	-	-	650.0	10.7
Ministry of Health	**72.9**	72.9	-	-	-	-	1.2
Ministry of Education	**1.0**	1.0	-	-	-	-	0.0
Ministry of Agriculture & Foodstuffs	**484.8**	372.4	6.5	96.2	9.0	0.7	7.9
Ministry of Sport	**137.2**	72.4	-	64.8	-	-	2.2
Ministry of Energy	**212.0**	212.0	-	-	-	-	3.5
National Academy of Sciences of Belarus	**116.6**	105.1	-	10.0	-	1.4	1.9
State Committee for Science & Technology	**5.2**	5.2	-	-	-	-	0.1
State Military Industrial Committee	**411.1**	-	-	395.1	-	16.0	6.7
Belbiopharm concern	**328.0**	310.0	-	-	-	18.0	5.4
Belgospischeprom concern	**19.7**	19.1	-	-	-	0.6	0.3
Bellegprom concern	**13.8**	10.0	-	-	-	3.8	0.2
Bellesbumprom concern	**2,021.9**	1,278.1	-	743.8	-	-	33.1
Belneftekhim concern	**735.2**	0.9	-	-	151.8	582.5	12.0
Brest regional executive committee	**59.2**	0.5	1.5	19.3	1.4	36.5	1.0
Vitebsk regional executive committee	**50.3**	16.5	-	33.8	-	-	0.8
Gomel regional executive committee	**32.3**	13.0	5.8	7.8	-	5.6	0.5
Grodno regional executive committee	**52.2**	-	0.0	37.0	4.9	10.3	0.9
Mogilev regional executive committee	**28.6**	-	0.8	-	1.6	26.3	0.5
Minsk City Council	**0.8**	-	-	-	-	0.8	0.0
Belkoopsoyuz	**25.9**	6.1	0.2	2.5	-	17.1	0.4
Total	**6,113.2**	**2,498.7**	**15.8**	**1,906.8**	**168.6**	**1,523.2**	**100.0**
% of total		***40.9***	***0.3***	***31.2***	***2.8***	***24.9***	***100***

[i] Includes Belarusian Innovation Fund.

Source: http://www.government.by/public/shared/rus/innovations_p/en/03.html, own calculations and modifications.

The outcome of this process is the State Programme for Innovative Development, which specifies detailed target figures in the form of indicators such as the number of (domestic and foreign) technologies to be introduced and the share of turnover that is based on innovative products. It also contains the budgetary funding allocated to the financing of innovative activities (see box 6).

Budget financing of innovation expenditures

The allocation of annual state budget expenditures for the State Programme for Innovative Development of the Republic of Belarus for 2007-2010 illustrates the implementation of innovation policy in Belarus in terms of public spending. The budget for 2010 contains 44 budget categories under this heading and expenditures of about 690 billion Belarusian roubles in 2010. This amounts to 7.4% of all budget expenses.[88]

The funding for the "Activities of the State Programme for Innovative Development," account for roughly half of the total Programme budget (46.5%, budget item 3.1, see table 23). These include a large number of innovation initiatives that range from technology parks to the sectoral activities of the ministries (see chapter 3 and below for more details). More than half (54.6%) of these resources are allocated to activities at the national level. Support for economic activities account for one third of the funding (33.2%). All other topics receive substantially less funding: health (5.5%), education (5.2%), physical culture, sport, culture and media (1.0%), defence (0.1%), and environmental protection (0,1%). 32 institutions - mostly ministries or institutions with the rank of a ministry but also enterprises and "other ministries and institutions" – are involved in the implementation of this state programme. There is also a notable concentration of funds by beneficiaries: the National Academy of Sciences accounts for 23,7% of all funds, "other ministries and institutions" – 19.5%, the Belarusian Innovation Fund – 14.3%, the State Committee on Science and Technology - 6.9%, the Ministry of Energy – 6.9%, the Ministry of Education – 4.2%, the Ministry of Economy – 2.5%, and the Ministry of Industry – 1.8%.

The remainder of the innovation budget is allocated to a number of additional programmes. The most important are different "State Complex Target Scientific and Technical Programmes", that are used to implement the objectives of the State Programme for Innovative Development (see chapters 2 and 3 for further details on programming structure). Altogether, these programmes account for 43.1% of expenditure, of which 23.8 percentage points correspond to the "State Programmes for Fundamental and Applied Research". The execution of these programmes involves 14 institutions of which the Academy of Science (70.5%), the Ministry of Education (22.1%), and the Ministry of Health (4.7%) take the largest shares. The second building block of the "State Complex Target Scientific and Technical Programmes" are the "State Scientific and Technical Programmes" (budget items 3.11 – 3.37, see table 23), which attract 19.3% of all innovation funds. Regional programmes account for 0.6% of the available resources.

[88] The Space programme - another area that is closely associated with research and innovation - accounts for 0.4% of the budget.

Table 23. Budget financing of the State Programme for Innovative Development, 2007-2010

Budget item No.	State Budget 2010: Appropriations for the State Programme for Innovative Development of Belarus, 2007-2010	2010 funds, BYR bn.	% total
3.1	State Programme for Innovative Development of Belarus activities, 2007-2010	320.7	46.5
3.2-3.10	Other programmes	67.3	9.8
	State complex target scientific and technical programmes		
3.11-3.37	State scientific and technological programmes	132.8	19.3
3.44	State programmes of fundamental and applied research in the fields of natural, technical, human and social sciences	164.2	23.8
3.38-3.43	Regional programmes	4.2	0.6
	Total	**689.2**	**100.0**

Source: http://www.pravo.by/webnpa/text.asp?RN=H10900073, own calculations and modifications.

The remaining 10% are accounted for by the following programmes:

- State Programme of Informatization of the Republic of Belarus for 2003-2005 and until 2010, "Electronic Belarus";
- The National Programme for the production of new and high technologies, 2006-2010;
- The State Programme "Innovative Biotechnology for 2010-2012 and for the period up to 2015";
- The State Programme "Chemical plant protection, 2008-2013";
- State Programme "Establishment of a national genetic stock of economically useful plants in 2007-2010";
- State Programme on development of software and hardware complex for automation of the calculation to be paid to the budget of taxes, dues (duties) and reporting to the tax authorities of tax returns (payments) in electronic form for 2008-2010;
- The State Programme for the creation of a single information state statistical system of the Republic of Belarus for 2007-2011;
- State Programme "Scientific support nuclear energy development in the Republic of Belarus for 2009-2010 and for the period until 2020";
- State Programme on development of import-substituting production of pharmaceutical substances, ready-made medicines and diagnostic tools in the Republic of Belarus for 2010-2014 and for the period up to 2020.

6.3. Financing instruments

The major sources of funding for innovation in Belarus are the "State Complex Target Scientific and Technical Programmes", which are instruments for pursuing the overarching objectives laid out in the State Programme for Innovative Development of the Republic of Belarus for 2007-2010. Other sources of innovation finance are the so-called innovation funds

which are managed by ministries and target sector specific objectives. A third channel is the Belarusian Innovation Fund, which is organized as a stand-alone institution outside the ministerial structures. Some small-scale private initiatives for the provision of financing to start-up companies are also emerging, although their significance is still very limited.

Innovation support through the state scientific and technical programmes

Innovation projects in Belarus usually involve co-operation between the National Academy of Sciences or another research institute or university and an enterprise. This is a result of the specialization pattern of the parties involved and the lack of research facilities at the enterprise level (see chapter 4). The National Academy of Sciences is the R&D "powerhouse" of Belarus which does most of the applied research and development work for innovating enterprises. This ranges from early phases of the product and process development to prototype development. Enterprises traditionally - this is a legacy from Soviet times - focus on the transfer of the prototype into a working production line but do little internal R&D investment (see chapter 4 for an extended discussion of this issue).

The National Academy of Sciences (or any other involved research institute) and the enterprises may receive funding for the innovation project from state, regional or sectoral programmes. The standard financial arrangement foresees that 50% of the costs of the research institute are covered by programme funds and the remainder by the enterprise. Implementation costs are not eligible[89] (see chapter 4). There may be deviations from this funding pattern if the State has a special interest in specific innovation activities. Space related development projects, for example, currently receive a higher share of appropriations out of public funds (up to 100% of the cost of the project). Enterprises must finance their innovation costs out of cash flows or through bank loans. Borrowing may require collateral but participation in state programmes may facilitate receiving loans from state-owned banks.

Box 7. Innovation expenditures in Belarus

In 2008, innovation expenditures amounted to BYR 3 trillion, of which 19.1% was devoted to R&D (see table 24). Corresponding figures for European countries vary substantially and are beset with measurement issues. In the most advanced countries, internal R&D expenditures account for 40-70% of innovation expenditures while catching-up economies spend 15-30% of innovation expenditures on internal and external R&D[i]. 8.5% of Belarusian innovation expenditures are used to acquire machines and equipment and 10.3% for product implementation. Expenditures in the remaining categories are negligible. Low spending on training may hamper productivity improvement, in particular if the innovation or the purchased equipment contains ICT components. A great number of studies have shown that the effect of new ICT technology can only materialize if employees are adequately trained and organizational changes are introduced[ii].

[i] Eurostat (2008), Science, technology and innovation in Europe.

[ii] Leo, H. (2001), ICT Investment & Growth of Output & Productivity, WIFO Working Paper 162, Vienna.

[89] Eligible costs are: Materials, wages salary of research-and-production personnel, social security and tax deduction, travel expenses, subcontracting, overheads and other direct costs.

Table 24. Innovation expenditures in Belarus, by category

Type of innovation expenditures	Funding, BYR bn.	Percentages
Research and development	562.3	19.1
Acquisition of machines and equipment	1569.7	53.3
Acquisition of new technologies	13.6	0.5
Acquisition of software	14.1	0.5
Training	3.9	0.1
Marketing research	9.0	0.3
Production implementation	250.2	8.5
Other expenditures	524.9	17.8
Total	**2947.6**	**100.0**

Source: State Committee on Science and Technology.

Private enterprises are allowed to apply for funding from state programmes if their innovation projects help to achieve the targets of the programme. Given the rather low number of private innovators this tends to be the exception rather than the rule. Applications for project funding are usually to be submitted in the autumn. The decision-making process takes around six months.

Innovation Funds

The innovation funds are accumulated by ministries, concerns and the National Academy of Sciences on the basis of levies imposed on affiliated institutions and enterprises to finance projects in their domain. As a rule, about 0.25% of turnover is levied; the most ambitious ministries may increase this percentage to as much as 10-15% of turnover (chapter 4).

The overall amount raised from these levies is complemented by budgetary financing provided under certain programmes which benefit some Ministries. For example, spending under the Innovation Fund of the Ministry of Energy was around 50% higher than the revenues raised as a result of this additional financing. A share of the revenues raised is transferred to the Belarusian Innovation Fund (see next section and table 25). For most Ministries and concerns, the percentage transferred is around 8% of revenues, although this is much lower for some of the larger Ministries. As a result, the resources accruing to the Belarusian Innovation Fund represented only 2.6% of the revenues raised by the sectoral innovation funds. Innovation Funds were incorporated into the budget in 2005. Information on these funds is routinely presented as part of the annual budget. Cash flows are monitored by the Ministry of Finance and they have been included in the Treasury system since that year.

Twenty six organizations have established their own innovation funds.[90] The Ministry of Energy (50%) and the Ministry of Architecture and Construction (23%) account for the bulk of expenditure. As suggested by their fields of responsibility, they spend a substantial share of the funds on investment in modernization rather than pure innovation projects. Overall, it is estimated that around 30% of resources are for scientific purposes and R&D. The remaining 70% go to projects that could be considered as investment projects.

Part of the resources accumulated in these innovation funds have been used to carry out initiatives contemplated in the State Programme for Innovative Development. In 2008, these projects accounted for 23.8% of the expenditures of the funds, up from 18.7% in 2007.

The ministries do not have to receive the approval of the State Committee on Science and Technology when allocating these resources. However, firms have to apply for these funds in a competitive process. Due to the cumbersome administrative procedures and reporting requirements, only 18% of R&D performing enterprises do apply for such funds.

Table 25. Innovation funds: revenues, contributions and expenditures, BYR billion

	Total revenues	Contributions to BIF	Contributions from budget	Total expenditures
Ministry of Energy	704.8	6.0	354.0	1,052.8
Concern Belbiopharm	1.3	0.1	-	1.2
Belneftekhim Concern	54.1	4.3		49.8
Concern Bellegprom	5.6	0.4	24.0	29.2
Concern Bellesbumprom	4.2	0.3	28.0	31.8
Ministry of Education	1.0	0.1	-	0.9
State Committee on Standardization	0.3	0.0	-	0.3
Ministry of Communications and Informatization	54.0	-	-	54.0
Ministry of Agriculture and Food	5.9	0.5	-	5.4
The State Property Committee	3.4	0.3	-	3.1
Ministry of Trade	0.7	0.1	0.9	1.5
Ministry of Finance	0.2	0.0	-	0.2
Ministry of Transport and Communications	173.3	3.9	-	169.4

[90] Innovation funds that are governed by the same principles exist also at the regional level.

Table 25. Innovation funds: revenues, contributions and expenditures, BYR billion *(continued)*

	Total revenues	Contributions to BIF	Contributions from budget	Total expenditures
Ministry of Housing	1.5	0.1	-	1.4
Ministry of Industry	115.0	9.2	-	105.8
Ministry of Architecture and Construction	503.2	12.1	-	491.1
Ministry of Information	3.5	0.3	-	3.2
Ministry of Forestry	11.5	0.9	-	10.6
Ministry of Sports and Tourism	0.0	0.0	-	0.0
State Military Industrial Committee	14.7	1.0	-	13.7
Department of Corrections Department of Internal Affairs	0.3	0.0	-	0.3
The Ministry of Defence	0.4	0.0	-	0.4
Belkoopsoyuz	50.0	4.0	-	46.0
The Ministry for Emergency Situations	0.1	0.0	-	0.1
National Academy of Sciences	0.4	0.0	-	0.4
Belgospishcheprom	25.2	2.0	-	23.2
Total	1,734.7	45.8	406.9	2,095.7

Source: http://www.pravo.by/webnpa/text.asp?RN=H10900073, own calculations and modifications.

The Belarusian Innovation Fund

The Belarusian Innovation Fund (BIF) is an institution within the structure of SCST that offers financial support for innovators, including private enterprises operating outside state, sectoral and regional programmes. The BIF was established in 1999 and provides funding to about ten projects per year with an overall volume of about $15 million ($22 million in 2011) in various sectors. Loans range from $50 thousand to $3 million. The average credit is around $600-700 thousand. The resources available to the BIF are a little below 3% of the resources raised by the institutional innovation funds described above.

The BIF thoroughly scrutinizes the projects to avoid losses in public funds invested, which is a top priority. The stringent screening of projects includes full auditing of the past performance of requesting enterprises. Funds are allocated only to innovative projects, with a clear priority given to projects related to national innovation programmes. Private companies

also benefit from the financial support of the BIF (box 8). The maturity of the credit is usually five years with a two-year grace period. Credits are granted at an interest rate that is half the base refinancing rate of the National Bank. The final product resulting from the project may receive guarantees of public procurement, thus increasing the likelihood of the loan being returned. Funded enterprises may also enjoy other regulatory privileges. The credit contract is a tripartite one: between the requesting enterprise, the Fund and a public body (branch Ministry, the Academy or a municipality), which pledges support to the project. Loans are not collateralized but the Fund has special rights to reclaim the outstanding money without going through the courts. There is widespread risk aversion which creates a bias toward low risk projects which are almost by definition incremental innovations or investment projects.

Box 8. ADANI: A success story supported by the Belarusian Innovation Fund

ADANI was founded in 1991 by former employees of the Research Laboratory for the Magnetic and Gamma-Resonance Spectroscopy of the Belarusian State University. It has become a leading company in the field of digital radiographic scanning for medical and security applications. Annual revenues are around $15 million. The company, which is fully private, has subsidiaries in both the USA and UK and a joint venture in China.

In 1999-2000 the Belarusian Innovation Fund (BIF) lent ADANI 174 million Belarusian roubles (about $150,000) at the rate of 63% payable in 2002 (the average commercial lending rate was over 100% at that time). This was to fund the development of mobile radiography technology for chest screening at a low level of radiation exposure. Such mobile technology can be deployed in rural areas and isolated communities, which would otherwise be difficult to reach.

The newly created mobile cabinet Pulmoexpress is certified in Belarus and the Russian Federation. The x-ray chest scanner installed in Pulmoexpress carries the CE mark and has the US FDA approval. The support of the BIF was crucial to develop a technology with considerable up front capital costs at a time of difficult credit conditions.

Box 8. ADANI: A success story supported by the Belarusian Innovation Fund *(continued)*

The BIF is helping ADANI to set up batch production of mammography systems in Belarus. A credit line was opened for ADANI for 11 billion Belarusian roubles (about $3.7 million) in November 2009. The payment of principal and interest has been deferred for three years, and the loan is repayable over a two-year period. The interest rate on the loan is half the base rate of the National Bank of Belarus.

Financial support provided by the BIF would allow ADANI to establish full-scale manufacturing of mammography systems in the country, thus substantially lowering the cost of production and facilitating access to state-of-the-art technology for early breast-cancer detection.

Risk capital

Risk capital is an important ingredient in innovation finance and all major developed countries are striving to create favourable conditions for the development of this form of investment. However, it is important to acknowledge that risk capital is a particular form of financing that reaches only a very small number of innovating companies and demands a complex set of conditions and institutions to work properly. In particular, risk capital tends to support radical innovations (i.e., based on fundamental research and expecting rapid growth), and reasonable exit options to disinvest (e.g. stock market or sale to other companies). The need for risk capital will increase as the innovation system in Belarus develops further.

New legislation has opened new possibilities for venture financing, which represents a first step in the development of new instruments supporting innovative start ups. Tax advantages are being granted to venture capital companies. It is envisaged that a new section within the Belarusian Innovation Fund would be able to grant venture financing. However, according to the current draft regulation, despite the name, the objective remains to achieve full repayment of each project funded, which is inconsistent with the notion of high risk financing. The regulatory base is not yet finalized. Equity financing by the BIF, with the option of selling the stake at a later stage, is another possibility being discussed.

The BIF also acts as a point of contact between companies and investors. A company that may not be financed (partly or fully) by the BIF for various reasons may be referred to other alternative sources of financing. This has in the past involved domestic banks, but the BIF is also actively showcasing Belarusian enterprises to international venture capitalists.

In general, venture capital is seen in Belarus as an important addition to the existing system of instruments that could have great potential to overcome some of the present problems in the financing of innovation. However, this is a complex task that will require incremental efforts and changes. International experience shows that no rapid results should be expected.

An important dimension of the public support for this form of financing is the creation of platforms that facilitate the dissemination of information about investment opportunities and allow investors to meet innovative companies. The first Virtual Belarusian Venture fair took place in November 2010 and presented investment projects in Belarus. Other grass root initiatives are emerging that create platforms for contacts between companies and investors. For example, the "Minsk Start-up Weekend" is an event to select promising investment projects which is organized by private investors. This initiative started in 2009 with 80 participants and seven investors. Participating investors are mainly based in Belarus, Russia and the US. Although there are still few instances of successful funding, this is a positive development, which is supported by formation of the first Belarusian Business Angel association.

6.4 Assessment

The present system is largely based on an innovation process that allocates research and development tasks to scientific institutions - mostly the National Academy of Science institutes - and the implementation work to the companies. Financial support is generally restricted to the R&D work carried out by the scientific institutes, whereas 50% of the costs are financed out of a programme and the remainder by the enterprise. Enterprises receive no direct support for their part in the innovation process, which in most cases remains somewhat limited. In the case of the "innovation funds", enterprises supply the major share of funding and participate in the redistribution of funds through projects that are selected on a competitive basis. In both cases, a share of project resources may be financed through directed bank loans. Besides funding from different public programmes the Belarusian Innovation Fund offers subsidized loans for innovation projects. In total, this funding system provides around 25% of the funds for technological innovation, which is quite a high share by international standards.

Risk aversion is a striking feature at all levels of the Belarusian innovation support system. This goes against the grain of the current consensus that risk is an innate feature of innovation projects, which in many cases fail. Failure in this context means that the project does not achieve the intended objectives, but may lay the foundation for unexpected discoveries or knowledge that helps to master the problem in a different way. By contrast, a conservative approach would tend to generally produce only incremental innovation.

In Belarus, if an innovation project fails - e.g. a technology is used for less than five years by a company - then the public subsidies granted must be repaid. In the case of the Belarusian Innovation Fund, projects are thoroughly checked in a lengthy procedure to avoid financing projects that might fail. Furthermore, the Fund possesses special privileges to confiscate outstanding money in case of failure. This situation reflects the intention to exclude imprudent and wasteful use of public resources but ignores the fact that risk-free innovations do not exist.

In most developed countries the risks intrinsic in innovation processes are shared between the innovator and public support institutions. This does not necessarily apply to all innovations but to a substantial part of them. These systems seek to manage overall risks by evaluating innovation projects, rejecting those that do not fulfil the necessary criteria and taking on a

share of risks in order to induce the innovator to conduct the project. Financial support can be provided as grants, where no repayment is expected, or equity participation, where the capital is preserved (or yields a positive rate of return), only if the project is successful. The exploration of new possibilities and the knowledge brought by these new initiatives brings benefits to society that cannot be captured by the returns on individual projects.

Support programmes and a developed financial system can make an important contribution to alleviate financing problems. However, the ability to generate revenues and retain access to the cash-flow generated is one of the most important sources for financing risky investments and innovation projects. The more risk involved in such a project, the more important are own sources as a form of financing. Belarus has already taken a number of measures that have reduced the tax burden on innovative companies in general or in specific sectors and institutions (e.g. reduced income tax of 10% for profits derived from the production of high tech products and services, tax breaks for companies in technoparks[91]). This will improve the ability to finance innovation from internal sources, reducing the need to provide direct state subsidy.

The first phases of an innovation project are the most difficult for start-up enterprises. This is because substantial financial resources have to be invested without receipt of revenues from the sale of the product. Overcoming this "valley of death" is a necessary precondition for gaining access to other sources of early stage financing. In Belarus, the development of risk capital has just begun. As in most countries, this would require substantial and continued public support to get the industry started. However, it is important to remember that risk capital is not a solution at the very initial stages in the life cycle of the company, when innovative firms are too small and too risky to attract the interest of risk capital providers. Grant financing from the Foundation for Fundamental Research of Belarus is available for scientific projects. Some grant financing may also be necessary to explore entrepreneurial opportunities that can then grow to a size sufficient to secure access to other sources of finance.

While the international experience may provide some guidance and useful examples regarding the structuring of innovation finance support systems, it is important to underline that the concrete mix of instruments and the institutional set-up needs to be adapted to the development of the country and the overall direction of the economic policy.

6.5 Recommendations

Financing is a critical dimension of the innovation process, especially with regard to the early entrepreneurial stage. Access to external finance is crucial for growth and a major constraint if not available in sufficient quantity. This is an area which remains underdeveloped in Belarus. Access to finance for SMEs in general and for service sector and exporting companies in particular is important in this respect. Availability of equity finance (stock market, business angels, venture capital) will be increasingly relevant as the catching-up process in Belarus

[91] UNCTAD (2009), Investment Policy Review of the Republic of Belarus, New York and Geneva.

progresses. A functioning banking sector and related support structures that create conducive framework conditions and sufficient funding for investment are also important ingredients of any development strategy.

Recommendation 6.1

The authorities need to undertake policy steps to expand and diversify the system of financial support to innovation taking into account that actions in this area need to be coordinated with other initiatives to overcome existing obstacles to innovation. Measures could include the following:

- *Granting targeted tax relief for innovation-related activities as part of policies to alleviate financing constraints of innovative enterprises and the SME sector (see also recommendations of chapters 2 and 3);*
- *Introducing new, early stage policy instruments such as subsidized loans, innovation grants/vouchers and guarantee schemes for eligible recipients/innovators (see also recommendations of chapter 4); and*
- *Providing targeted public support to facilitate the development of a well functioning private infrastructure of early stage financing.*

The system of public support to innovation and provision of entrepreneurial finance in Belarus has a built-in feature of strong risk aversion. While the concern to ensure an appropriate use of public funds is understandable, it is also true that no radical innovation can take place without risk. Public support is critical precisely because the public sector can take more risks than private operators and can explore more opportunities for the benefit of society at large. This understanding needs to be reflected in the design and functioning of financial support mechanisms.

Recommendation 6.2

To be effective in promoting innovation, the system of public support for innovation activities in Belarus needs to accept increased levels of risk and be more tolerant of possible failures of individual projects. Incorporating higher tolerance in this system of risk may involve:

- *The introduction of a non-repayable grant scheme, which provides financing to explore new ideas, irrespective of the outcome of the innovation process;*
- *Introducing acceptance that not all individual projects which are approved for public funding will necessarily be successful; this could be done by specifying concrete conditions under which existing penalties for failure would not apply (see also recommendations in chapter 4); and*
- *Introducing modifications in evaluation procedures to incorporate well-specified criteria for tolerance of possible failure for highly innovative and prospective projects.*

Belarus runs a large number of programmes that aim to foster innovation. In some cases, they promote technological investments in modernization rather than genuine innovative efforts.

Distinguishing between investment- and innovation-based development processes is important for the organization of support structures. The outcome of investment projects is easier to predict than that of genuine innovation projects, and so they are better suited to being supported through the banking system. Public support may be warranted if the banking system does not supply sufficient funding or discriminates against certain types of investments or investors (SMEs, exporters, service sector companies). By contrast, there is a need to expand the scope and diversify the instruments for support to genuine innovation. Equity participation in innovative projects as a specific form of early stage financing implies the sharing of risks, including the possibility of losses.

Recommendation 6.3

There is a need to reconsider and re-focus the existing instruments for public support to innovation projects in Belarus to take into account the different types of risks involved in different types of projects. Such an effort could be combined with steps to expand the scope and diversify the instruments of support for genuine innovation. The policy steps in this direction could include the following:

- *Public support to modernization through new investment (projects of relatively low risk) could be restricted to SMEs only, to reflect their difficulties in accessing bank finance;*
- *The criteria for extending public finance to (high risk) genuine innovation projects need to be clearly spelled out, with the risk involved being an inherent feature of such a specification;*
- *Instruments of public support to genuine innovation projects need to be extended and possibly diversified, depending on factors such as size, duration, level of risk etc.;*
- *The running of such public support schemes could be entrusted to specialized financial institutions (rather than to public bodies); one possible avenue for this could be through the reorganization and further development of the Belarusian Innovation Fund as a source of financing for innovative projects;*
- *Another avenue could be the design of new forms of public support for venture capital financing.*

Simplicity is an important feature of any innovation support system. The present system in Belarus is already quite complex and may be a challenge to deal with, in particular for private sector participants. At the same time, it is very articulated as regards the expected outcomes of innovation processes in terms of specific products or achievements. Successful innovation is inherently difficult to predict. While the definition of state priorities may be an important component of the guidance role provided by the public sector in the innovation process, it is important that other potential areas of innovation are not neglected. In the current system, innovation activities that were not foreseen by the administration, and therefore remain outside these programmes, are difficult to support.

Recommendation 6.4

In order to simplify the system of innovation support and remain open to new innovation possibilities, the authorities could:

- *Streamline state-run programmes, regrouping them into technology-oriented, mission-oriented or general purpose programmes (see also recommendation in chapter 3);*
- *Remove support to modernization programmes from the remit of state-run innovation programmes (with the possible exception of such support to SMEs); and*
- *Develop and reinforce a general purpose innovation programme, which has no specific technological or sectoral focus. One possible way of doing this could be on the basis of a reorganization of the Belarusian Innovation Fund (recommendation 6.3).*

Chapter 7

INNOVATION AND INTERNATIONAL ECONOMIC INTEGRATION

This chapter addresses some of the international dimensions of innovation with a view to bringing them together and assessing them in terms of their contribution to the international economic integration of Belarus. The chapter begins with a consideration of the existing institutional and legal framework supporting international integration, including FDI. Special attention is paid to multilateral initiatives for economic cooperation, including those with the Commonwealth of Independent States (CIS), the Eurasian Economic Community (EurAsEC) and the EU, integration with Russia and Kazakhstan through the recently formed Customs Union in the context of EurAsEC, and the scope to widen markets and pool research efforts on the basis of a common industrial and technological legacy, as well as building new linkages. In particular, it considers existing interactions with international organizations of relevance to innovation activity and innovation policy. This analysis serves as the basis for drawing a number of policy conclusions and recommendations.

7.1 Institutional framework for international cooperation targeting innovation

Legal framework

Belarus has a record of active participation in the field of international scientific and technical cooperation. Bilateral agreements with six countries[92] were signed in 2000-2001 concerning the certification of researchers and academics at the highest level of qualification. Since 1999, agreements with 22 countries have been signed relating to cooperation in the fields of education, science and technology.

An agreement on the creation of an integrated scientific and technological space in the CIS was signed in 1995 and extended in 2010 with a decision by the Council of Ministers. Provisions for the participation of research organizations and specialists of the CIS countries in science and technology programmes in Belarus have been incorporated in the legislation since 1999 (Law No. 316-Z).

The recently founded EurAsEC Center of High-Technology (established in accordance with the 2009 decision by the high-level Interstate Committee of EurAsEC), also provides new opportunities for cooperative efforts targeting joint innovative projects undertaken by EurAsEC member countries.

In 2003, the Decree of the President of the Republic of Belarus established the framework of state regulation for International Technical Assistance (ITA), granting preferences and administrative support to participants in the provision of international technical assistance to

[92] Tajikistan, Kazakhstan, Ukraine, Armenia, Moldova and Azerbaijan.

Belarus. In 2006, the National Programme on the International Technical Cooperation for 2006-2010 was approved. This programme is coordinated by the Ministry of the Economy.

Scientific and technical cooperation with the European Union is based on conclusions of the Foreign Affairs Council of the EU (most recently, in October 2008 and November 2009). Projects supported by the EU in Belarus follow the guidelines of the Country Strategy Paper 2007-2013 and National Indicative Programme 2007-2010. A cross-border programme of cooperation between Poland, Belarus and Ukraine for 2007-2013 was approved by the EC in 2008.

Institutions supporting international cooperation

There is a range of institutions engaged in international cooperation; institutions which are often co-funded from Belarusian and international sources. One of the advanced institutes specifically designed to promote cooperation between the developers and users of high technologies and potential investors, including foreign investors, is the Republican Centre for Technology Transfer (RCTT) (see also the discussion in chapter 5 and the annex).

The Belarusian regional branch of the International Scientific and Technical Centre is an intergovernmental organization which has been active in Belarus since 1996. Its mission is to facilitate the reorientation of scientists involved in defence to other activities, encouraging their integration into the world scientific community and providing support to fundamental and applied research and technical developments.

The National Coordinating Unit (NCU) of the European Union TACIS Programme was created in 1997, being responsible for managing EU programmes and projects in Belarus. There is also the National Information Office of the FP7 in Belarus (NIO), created in 2004 with the objective of providing support to operating and potential partners of the FP7.

There is a range of specialized departments within governmental organizations providing support in the area of international cooperation. For example, the State Committee on Science and Technology has a department for international scientific and technical cooperation for areas within its competence. At the Ministry of the Economy, the Principal Division on Investments develops measures to strengthen cooperation with foreign countries in joint investment projects, while the Principal Division on External Economic Policy participates in the development of the strategy, directions and mechanisms regulating external economic relations. The Ministry also plays a key role in cooperating with international organizations and in the coordination of technical assistance. The Ministry of Industry has a Division for Innovation and Investment Activity, and a Division on External Economic Relations. The Belarusian Institute of Systems Analysis and Information Support for the Scientific and Technical Sphere (BelISA) has a “Centre for Foreign Economic Innovation and Scientific and Technical Cooperation and Investment” that monitors and analyzes the status and trends of international cooperation in science, technology and innovation activities. Additionally, this Centre provides policy advice and intelligence, helping to attract FDI to Belarusian high-tech sectors and enhancing cooperation between Belarus and the EU in the field of science and technology. Also at BelISA is the “Centre of analysis of world technological trends and forecasts”, which provides monitoring and analytical services.

The institutional and legal framework to facilitate international cooperation is well developed in Belarus. Agreements concluded at the governmental level have driven a range of initiatives seeking to "internationalize" R&D activity. International cooperation has been institutionalized through specific departments in the structure of ministries and organizations of the Belarusian national innovation system. As an example, box 9 illustrates the international agreements in the sphere of intellectual property rights to which Belarus is a party (see also chapter 5).

Box 9. International agreements on intellectual property rights to which Belarus is a party

1997	• Nice Agreement Concerning the International Classification of Goods and Services for the Purposes of the Registration of Marks; • Strasbourg Agreement Concerning the International Patent Classification; • Locarno Agreement Establishing an International Classification for Industrial Designs; • WIPO Performances and Phonograms Treaty; • WIPO Copyright Treaty;
2001	• Budapest Treaty on the International Recognition of the Deposit of Micro-organisms for the Purposes of Patent Procedure; • Protocol Relating to the Madrid Agreement Concerning the International Registration of Marks;
2002	• International Convention for the Protection of New Varieties of Plants;
2004	• International Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organizations; • Convention for the Protection of Producers of Phonograms Against Unauthorized Duplication of Their Phonograms; • Agreement on Measures for the Prevention and Repression of the Use of False Trademarks and Geographical Indications.

However, there are also some gaps which constrain further development of international S&T cooperation. Thus foreign aid for R&D, international technical assistance projects/programmes and small grants awarded on the basis of competition are still not well covered by the existing legislation.[93] Another problem is that the authorization of funding for small research projects of individual researchers often requires a very large volume of paperwork. This may lead individuals to not report the funding to their organizations, or even to choose to not make use of research grants that have been awarded.

7.2 Forms and directions of international S&T cooperation

International S&T cooperation in Belarus is actively developing in many directions. It encompasses governmental efforts on setting a legal framework for cooperation with one group of countries (Italy, Qatar, Kuwait, Saudi Arabia), awareness-raising delegations of representatives of governments and organizations (Sweden, United Arab Emirates, Syrian

[93] A. Pinigin, E. Laevskaya (2009), International Technical Assistance in the Republic of Belarus. Questions and Answers, Yunipak, Minsk.

Arab Republic) and jointly financed projects with other countries (Germany). Simultaneously, S&T cooperation at the level of particular firms (through the export of goods and technologies, outsourcing R&D and the establishment of joint ventures), and individuals (scientific conferences, joint publications, research visits and labour mobility) is also developing much faster, independently of international agreements.

The state priorities for international S&T cooperation defined in 2007 included: ICT development, technological exchange, infrastructure for innovative entrepreneurship, the atomic energy industry, space engineering and technologies and the training of highly skilled staff. The principal areas of international scientific and technical cooperation includes bilateral cooperation with non-CIS countries; cooperation within the Union State of Russia and Belarus; cooperation with the CIS and EurAsEC member states; the development of multilateral cooperation and interaction with the leading international organizations and centres and the development of the modern information and communication basis. As an example, in 2010 the EurAsEC Innovation Centre in railway development was established with the participation of the Belarusian railways.

Bilateral co-operation with non-CIS countries

The types and areas of specialization in bilateral cooperation differ between countries. Belarus has pursued a mixed approach, including top-down approaches where appropriate. Thus, the 2003 agreement between the Belarusian Republican Foundation on Fundamental Research and France's National Centre for Scientific Research (CNRS) opened the way to jointly financed projects. Multi-stakeholders approaches, such as with the countries of the Baltic Sea region, have involved cooperation at the governmental, university, research institute and infrastructure organization levels.

Cooperation within the Union State of Russia and Belarus, CIS and EurAsEC

Cooperation with Russia is the most developed. Following an Intergovernmental agreement on science and technologies between the Republic of Belarus and the Russian Federation in 2007, there are 22 joint projects in a wide range of scientific directions. The Siberian Branch of the Russian Academy of Sciences is involved with the NAS of Belarus in 51 joint scientific and technical projects on priority directions of scientific research, and a range of other joint projects.

Within the framework of scientific and technical programmes of the Union State of Belarus and Russia, programmes have been launched or are being prepared in the following areas:

- Laser technologies;
- Nanomaterials and nanotechnologies;
- Research-intensive components of general machine-building application;
- Stem cells transplantation for after-care of pathologically changed tissues and organs;
- Grid-technologies for high-productivity calculation systems; and
- Light-emitting diodes.

Projects within joint programmes in the following areas were discussed in February 2010 by the Commission of the Parliamentary Meeting of the Union State on economic policy:

- Development of a hardware-software infrastructure to enable high-efficiency calculations in industry; and
- Intellectual innovative technologies and systems in science, education and the economy.

There is a joint R&D programme "Development of basic elements and technologies for the creation and application of orbital and land devices of a multifunctional cosmic system" of the Union State of Belarus and Russia for the period 2008-2011. Goals include the development, manufacture and mastering of an experimental sample of a micro-satellite, and other technological advances. Participants will include universities, R&D institutes and centres, enterprises and companies from both Belarus and Russia.

Joint competitions for S&T projects have helped maintain and develop S&T links with other CIS countries. In the CIS, the International Association of Academies of Sciences (IAAS) serves as a platform for interactions in the field of fundamental and applied research and education.

In the context of EurAsEC, the new Interstate Programme “Innovative biotechnology”, actively promoted by Belarus, envisages total funding amounting to 1 billion Russian roubles for the period 2011-2015 in support of innovative projects.

Box 10 presents an example of a Participatory action plan on development of cooperation in the field of ICT signed with Azerbaijan.

Box 10. The participatory action plan on cooperation in the field of ICT with Azerbaijan

The following actions were envisaged in 2009:

- A joint Belarus-Azerbaijan business forum drawing on the positive experiences of the Belarusian Park of High technologies with participation of Azerbaijan ICT companies;
- Preparation of training in computer science and radio electronics by the Belarusian State University of highly skilled experts for the Ministry of Communications of Azerbaijan and its ICT sphere as a whole;
- Cooperation of the Belarusian National Technical University (BNTU) with Azerbaijan in the field of development of the concept, architecture and software of the integrated system of safety of territorially distributed objects;
- Proposals of Grodno State University concerning the development of models of information-computer networks and productions, high-precision radar-tracking measuring instruments, etc.;
- Project on the creation of the ICT infrastructure, initiated by Azerbaijan within the framework of the Trans-Eurasian fibre-optical highway.

Multilateral cooperation and international organizations

Belarus cooperates actively with such leading international organizations and centres as the Joint Institute for Nuclear Research, the European Organization for Nuclear Research (CERN), the United Nations Industrial Development Organization (UNIDO), the United Nations Development Programme (UNDP), the World Intellectual Property Organization (WIPO), the International Science and Technology Centre (ISTC), the International Atomic Energy Agency (IAEA) and the European Union via the 6th and 7th Framework programmes of scientific research and technological development.

Belarus took part in five IAEA coordinated projects in 2008. During the period 2009-2011, four new national projects have been included in the Programme on nuclear power, medicine and overcoming the consequences of the Chernobyl accident. Meanwhile, in 2009 the ISTC approved financing of $1 million for two Belarusian projects, which is the outcome of 15 years of active cooperation with the ISTC.[94] In 2008, the UNDP had 30 projects in Belarus at different stages of implementation, with total programme expenditure exceeding $10.5 million.

There are ongoing discussions with the European Commission to increase the participation of Belarusian scientists' in the 7th Framework Programme. The National Information Office of the FP7 in Belarus has developed an extended network of Belarusian scientists and organizations wishing to join the EU R&D community and is active in providing support to Belarusian applicants, who have been particularly successful in the fields of ICT and nanotechnologies. Belarus also participates in Erasmus Mundus - an EU educational programme focusing on the facilitation of international academic cooperation and mobility.

The Centre for International Research of the Belarusian State University is included in the Global Network of Research Development Centres of UNCTAD, which was built to become a forum for the discussion of issues of globalization and development strategies, investments and the development of entrepreneurship, international trade, science, technologies, ICT and related issues.[95]

International technical assistance (ITA) represents an additional resource contributing to sustainable social and economic development. The state policy in the field of ITA is developed by the Ministry of the Economy through the National Programmes of International Technical Cooperation (NPITC). The NPITC for 2006-2010 is based on the Programme of Social and Economic Development of Belarus for the same period, and the National Strategy of Sustainable Social and Economic Development of Belarus for the period until 2020.

Belarus has made active use of national co-financing while implementing the ITA projects and programmes (around 16% of financing). The key partners on the Belarusian side of the ITA process are governmental bodies, both by the number of registered projects and by financing.[96] Belarus participates in UNIDO-sponsored innovative projects both directly and in

[94] http://pda.ng.by/ru/issues?art_id=33950&is_pril=1
[95] http://www.centis.bsu.by/rus/index.htm
[96] International Technical Assistance in the Republic of Belarus, 2002-2007, Minsk, 2009.

accordance with the EurAsEC Memorandum of Understanding with UNIDO. Since 2010, Belarus has been implementing a UNIDO-led project co-funded by the Russian Federation in support of regional industrial integration in EurAsEC countries and promoting their global integration linkages.

Participation of Belarusian institutions in international S&T cooperation

Universities are actively involved in international cooperation in S&T related areas. In 2007, they collaborated with over 58 countries, and fulfilled contracts to deliver scientific and technical products to 30 CIS and non-CIS countries, which generated exports earnings of around $3.5 million. The main partners came from Russia, Germany, Ukraine, Italy and Kazakhstan.

The National Academy of Sciences of Belarus represents the country in international scientific organizations, such as the International Council for Science (ICSU), the European Federation of National Academies of Sciences and Humanities (ALLEA), the Global Network of Science Academies (IAP), the International Association of Academies of Sciences (IAAS), the International Centre for Scientific and Technical Information (ICSTI), the International Union of Pure and Applied Chemistry (IUPAC), the International Congress of Mechanical Engineering Societies (ICOMES), and the International Centre for Heat and Mass Transfer (ICHMT). NAS Belarus has signed 67 cooperation agreements with foreign academies of sciences and other scientific organizations. In 2009, R&D organizations of the NAS cooperated with research centres from 79 countries.

The Belarusian Republican Foundation for Fundamental Research (BRFFR) seeks to develop international linkages through the financing of joint projects with other funding organizations and the provision of financial aid for participation in scientific events abroad (see table 26).

Table 26. International projects funded by the Belarusian Foundation for Fundamental Research

Partners	Projects presented	Projects approved
Fundamental Research State Foundation of Ukraine	128	64
Russian Humanitarian Research Foundation	45	15
Science-International Cooperation	48	32
Joint Institute of Nuclear Research in Dubna	11	6
Science and Technology Foundation of Mongolia	10	9
National Centre for Scientific Research of France	10	10
Cross-border regional call of BRFFR - Belarus, RFFR - Russia and FRSF - Ukraine	15	4
Vietnam Academy of Science and Technology	6	6
National Academy of Sciences of Azerbaijan	8	8
Siberian Branch of the Russian Academy of Sciences	20	20
Ural Branch of the Russian Academy of Sciences	3	3

Source: Belarusian Foundation for Fundamental Research.

The number of international projects has almost doubled since 2005. Sciences and informatics are the most active disciplines, accounting for some 40% of projects. These disciplines have also had more success in attracting foreign funds (65% of the total) and achieving publications in international journals. In 2010, the BRFFR decided to concentrate its activity on the support of international projects and projects of young scientists while increasing funds available for the participation of Belarusian scientists in international conferences.[97]

The National Centre for Intellectual Property (NCIP) participates actively in WIPO Committees and Working Groups, and organizes seminars on related topics. Cooperation between the NCIP and the CIS countries in the field of IPR protection has been carried out on the basis of intergovernmental and interagency agreements. These include, for example, the production of a regional patent information product on CIS countries, available as a CD-ROM. Belarus also cooperates actively with the Eurasian Patent Organization (EAPO), who provided technical assistance for the preparation and publication of the electronic version of the Official Bulletin "Inventions, Utility Models, Industrial Designs," on the basis of IT products designed by EAPO. Cooperation with the European Patent Office (EPO) concerns the harmonization of intellectual property legislation to conform to EU legal standards. In 2009, Belarus exchanged patent documents with 28 foreign countries.[98]

Innovation infrastructure organizations from Belarus cooperate with similar organizations from the Baltic Sea region countries, and from Far East countries, in particular. The RCTT participates in two international projects: "Strengthening the National System for Technology Transfer in the Republic of Belarus on the Basis of ICT" and "Information Technologies to Open Knowledge for Eastern Europe and Central Asia" (www.istok-soyuz.eu). The Belarusian Innovation Fund cooperates with the German Federation of Industrial Research Associations, UNIDO and the Russian Association "Technopark". This cooperation has led to the creation of several joint technology transfer centres under the technological park "Polytechnic" of the BNTU.[99]

Some conclusions

Belarusian organizations and researchers have developed a wide range of cooperation initiatives in scientific and technical areas, in particular concerning cooperation among Academies of Sciences. Informal networks in the CIS, which reflect the legacy of sharing a common state, have played an important role in facilitating international cooperation. By contrast, cooperation at the enterprise level is less developed, in particular concerning SMEs.

There are a number of barriers that hamper the intensification of international collaboration. Shortcomings in the institutional framework supporting cooperation and some rigid conditions in the development of existing relations are negative factors that make closer relations difficult.

[97] V.A.Orlovich, On the work of the Belarusian Republican Centre for Fundamental Research in 2009 and prospective activities in 2010. Report to the Council, 29 April 2010.
[98] Annual Report of the National Intellectual Property Right Center, 2009.
[99] http://www.metolit.by/en/dir/index.php/1682

There is a very small number of joint international R&D centres in Belarus. The scientific infrastructure to attract leading foreign scientists is insufficient. The international scientific research centres which are planned in CIS countries are a promising development. The International Innovation Centre of Nanotechnologies of the CIS countries which was established by the IASS, Kurchatov Institute and the Joint Institute for Nuclear Research is one such pioneering initiative, which is contributing to the creation of a common scientific space in the CIS. Belarus has yet to suggest that such a centre be organized under the framework of IAAS.

An important institutional factor constraining international technical assistance from the EU is the lack of a comprehensive legal foundation for Belarusian cooperation (the Partnership and Cooperation Agreement between the EC and Belarus, signed in 1995, has not been ratified).

Other barriers include:

- The system of double approval and registration of programmes and projects at the national level, after the international committee has approved funding. This is quite complex and delays the start of operations;
- Overhead costs for project realization are high in many of the large R&D organizations and universities;
- The same administrative procedures for registration and taxation apply to small research grants (e.g. below $10,000) and large projects; and
- A shortage of appropriate skills prevents closer international cooperation in S&T. These include a lack of required competences in drafting project proposals, language barriers and weak international contacts.

7.3 International knowledge flows

Cross-border mobility of scientists

Since the late 1980s, there has been a large scale exodus of skilled labour, including scientists, from the former Soviet Union and Eastern Europe. Highly skilled Belarusian workers have migrated to high income countries. Expert analysis by the Centre for Monitoring the Migration of Scientific and Pedagogical Staff (CMMSPS) at the Institute for Sociology of the NASB estimates that the main destinations for scientists and university lecturers during 1996-2008 were Germany (23.1%), the USA (21.5%), Canada and Israel (9.2% each) and other EU countries.

Short-term international mobility of scientists has been greatly facilitated by the existence of long-term scientific linkages with neighbouring countries. In 2004-2008, Russia, Lithuania, Latvia, Poland and Ukraine accounted for 75.7% of all such visits abroad, with Russia being the destination for 56.8% of all moves by scientists. Scientists in technical and natural sciences have been the most mobile in this sense. However, 57.9% of PhD students have no

experience of international cooperation, and of those possessing such experience, 28.4% have never been abroad.[100]

In Belarus, there are two different directions of international integration of postgraduate scientific education. The CIS dimension is supported by a number of international agreements and legal acts. The agreement between Russia and Belarus on equal rights at all levels of education (1998), the establishment of the Intergovernmental Belarusian-Russian Committee on Scientific and Technical cooperation (2002) and the launching of the Inter-State Programme "Provision of an Integrated Scientific and Technological Space" (2000-2005), have driven integration with CIS countries. In addition to the development of closer links with CIS countries, the participation of Russia in the Bologna process in 2003 required harmonization of the educational structure in Belarus with that in Europe. One of the main issues for Belarus is the transformation of the two-level system of scientific degrees ("candidate of sciences" and "doctor of sciences"), into a one-stage Ph.D. (doctorate) system followed by the stage of habilitation, which has potential to facilitate cooperation with foreign institutions.

International technology trade and trade in high-tech goods

Participation in the international market for technologies is significant and increasing. From 2006 to 2008, the share of new technologies acquired by Belarusian organizations from abroad increased from 38.7% to 60% of total technology purchases. There has been a trend towards increased diversification of supply sources, resulting in lower market shares for technologies originating in CIS countries. The acquisition of equipment is a widespread driver of economic modernization. By contrast, only a few organizations are involved in the purchase of patents and technologies. In 2006, for example, only ten organizations participated in patent, licence, useful models or industrial sample acquisitions, with an average of 6.7 acquisitions per organization.

Russia remains Belarus' main trading partner both in terms of the number of concluded transactions, and their total value: in 2007 it accounted for 51.6% of all import transactions and 45% of export transactions. The second largest partner by number of transactions is Ukraine (16.9% of imports and 6% of exports). From the countries of the European Union, Germany is in the lead (68 import and 65 export transactions); the other major European countries have approximately equal shares in the total number of transactions. The main exception to this pattern is in the purchase of equipment, for which the main source in both 2006 and in 2008 were the developed market economies.

In unit value terms, imported foreign technologies are more expensive than those sold abroad. In 2007, the average unit value of an imported technology was $158,000, against $85,000 for exported technologies.

Royalty and licence payments have a negative balance ($70.2 million in 2008 against $49.4 million in 2007). However, the number of registered contracts on intellectual property

[100] M. Artyukhin (2009), Scientific Staff and the Innovative Development of the Republic of Belarus, Bel. Navuka, Minsk.

has grown continuously, in particular concerning licence contracts. In recent times, the greatest number of both export and import transactions relating to technologies and services of a technical character have been in the area of engineering services.

The Catalogue of High-Tech Goods Produced in Belarus[101] reflects Belarusian export capacity in a number of high-tech and science intensive areas. Electronics and communication products and scientific devices account for around two thirds of high-tech exports. However, trade in such products was in deficit in 2008. Although exports of high-tech goods grew by 13.8% over the period 2007-2008, growth of imports in the same period was even higher, at 21.9%.

Table 27. International trade in high-tech goods, $ million and percentages

	Exports		Imports	
	2007	**2008**	**2007**	**2008**
All goods	**24,275**	**32,902**	**28,693**	**39,483**
High-tech goods *(comprising, % shares)*	791	900	2,067	2,520
Chemical products	*13*	*12.3*	*10.3*	*10.7*
Electric machines and devices and their parts	*2.2*	*2.2*	*2.1*	*1.9*
Scientific devices	*22.1*	*25.1*	*17.1*	*19.1*
Non-electric equipment	*8.1*	*7.6*	*6.7*	*6.5*
Pharmaceutical products	*7.5*	*8.4*	*18.1*	*19.3*
Aerospace equipment	*6.4*	*4.7*	*5.5*	*4.3*
Computing and office machinery	*1.2*	*0.5*	*11*	*7.5*
Electronics and telecommunication	*39.5*	*39.2*	*29.2*	*30.6*
Share of high-tech in all goods (%)	***3.3***	***2.7***	***7.2***	***6.4***

Source: I. Voitov et al (2009), On the state and perspectives of development of science in the Republic of Belarus following the results of 2008: Analytical report, Minsk, BelISA.

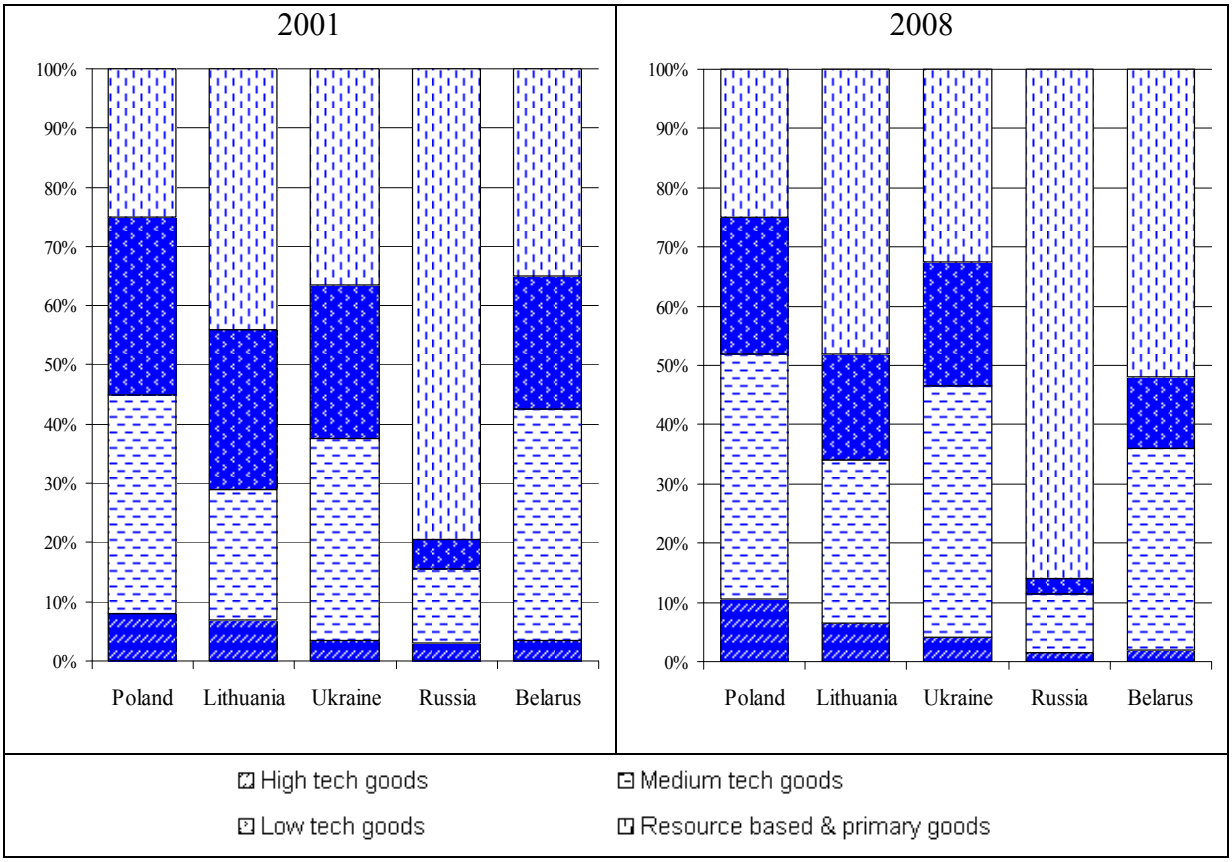
During 2007-2008, the highest growth in high-tech exports was for scientific devices (29.1%), pharmaceutical products (26.3%), electronics and telecommunication (12.8%), while exports of aerospace equipment, computer and office equipment decreased. Among high-tech imports, the fastest growth was in scientific devices (36%), non-electric equipment (19%), electronics and telecommunication (27.8%).

This deficit, however, is not necessarily a negative outcome, as the import of high-tech products is a channel for the cross-border diffusion of innovation, contributing to an increase in the technological capacity of the country and boosting productivity.

Changes in the structure of exports, however, show deterioration in technological intensity, with a declining share of high-tech goods and an increase in the relative importance of resource-based exports (see chapter 1).

[101] I. Voitov (ed) (2008), Catalogue of High-Technology Goods of the Republic of Belarus, Issue 2, BelISA, Minsk.

Figure 13. Export shares by technological level for selected countries, per cent, 2001 and 2008



Source: World Bank (2010), Belarus. Trade Performance and Competitiveness, Belarus Economic Policy Notes: Note No.2, Washington, D.C, World Bank.

Some conclusions

There has been evidence of a "brain drain" in Belarus, as a number of highly qualified scientists moved to other countries, including the US, EU and Russia, in recent years. Although this "brain drain" has been relatively limited, it suggests that there is a need to create better domestic conditions to retain the best talent in the country.

Opportunities for international mobility have improved in recent years. The frequency of participation at international conferences more than trebled over 2004-2008, while joint research and joint projects almost doubled. However, participation in study tours and internships abroad, as well as participation in international research contracts, remains weak. Although most PhD students are satisfied with the domestic opportunities for research, they have limited opportunities to participate in international conferences and research-stays abroad or to apply for foreign grants.

The market for scientific and technical products in Belarus is gradually developing, accompanied by an increase in the international trade of high-tech goods and services.

However, a weak tradition of intramural research is an impediment to the expansion of science and technology-based firms, both domestically and internationally. The weakness of domestic demand for innovation may encourage S&T firms to internationalize their activity, if they are sufficiently competitive. State demand may provide an initial testing platform in the early development stages of internationally oriented companies, thereby increasing the likelihood of success on world markets. Certification and standardization issues present additional barriers to the penetration of foreign markets. Discrepancies between domestic and EU standards prevent companies from serving both markets without incurring additional costs.

Another important issue for Belarusian innovative firms at the international level concerns the protection of their intellectual property in other jurisdictions. Few firms can finance applying for and maintaining patents in the EU or USA due to the high up-front costs. Domestic patents provide information to potential competitors without granting innovators worldwide protection. The lack of patenting capabilities restricts the options for domestic companies, who may be forced to sell or share their technologies.

Due to inadequate regulation and regulatory capacity, there are frequent conflicts regarding the sharing of intellectual property rights in joint R&D outputs with foreign partners. Most enterprises and R&D organizations do not have specialized departments or highly qualified staff to address patenting and licensing issues. International issues regarding IPR management are not well covered in the educational system. Special schemes to facilitate IPR protection, including co-financing of international patents by the State, complemented by educational and consulting services for both traditional and innovative enterprises could make a positive contribution to addressing weaknesses in this area.

7.4 International cooperation via CIS, EurAsEC and other mechanisms

Opportunities and challenges within the CIS and EurAsEC

Deepening international integration and cooperation can provide improved opportunities for scientific and technological progress and increased access to new technologies, including through the diffusion of tacit knowledge. These beneficial effects can take place through a variety of channels, including as a result of joint projects, technology transfer to less developed sectors and improved employment prospects for scientific staff.

However, such cooperation also contributes to the development of long-term networks of individual scientists and institutionalized forms of cooperation between partner organizations, while enhancing national competitiveness in an increasingly integrated international economic space. Belarus could therefore benefit by actively promoting a multi-dimensional participation in the international economic community: a strategy oriented on both the preservation of existing economic linkages with Russia and the other CIS countries, combined with an intensification of linkages with the EU.

The creation of a common S&T space and a single market for the commercialization of R&D results would significantly lower the transaction costs of technological trade and open new possibilities for technological development. Belarus has a unique position at the crossroads of

two major economic regions, the EU and the CIS. The Common Economic Space which is being established within EurAsEC (based on 17 interstate agreements covering key sectors of economic activity as well harmonization in technical regulations and standards) is expected to provide further impetus to cooperation in innovative projects and in the modernization of EurAsEC economies. The Customs Union with Russia and Kazakhstan which is another important area of economic integration within EurAsEC creates a large market free of customs barriers that defines better prospects for cooperation, underpinned by common trade and competition policies.

However, the benefits of the Customs Union will depend on the adoption of complementary policies that target technological modernization and promote a shift in the trade structure towards goods of a higher technical sophistication. Cooperation within the Customs Union has created scope for concerted policies with potentially larger benefits than national solutions. As wage levels rise and tend to converge with those of more developed countries, labour cost advantages will probably be eroded. New forms of competitiveness based on technological development would be required (see chapter 3 for a discussion of this rationale for innovative development).

Beyond the Customs Union, the Eurasian Economic Community (EurAsEC), including Armenia, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Uzbekistan and Ukraine, provides a wider scope for cooperation. This enlarged space will make it possible to preserve and develop production linkages which existed under the former Soviet Union in new conditions.

The integration links within EurAsEC have significant potential to contribute to the innovative development of Belarus, including through:

- Scientific research and production manufacturing subsystems developed through division of labour and complementary specializations;
- Shared institutes to facilitate interpersonal relations in the absence of language barriers;
- Networks of contacts accumulated in the professional scientific sphere, especially among the leading scientists of scientific schools.

The reconstruction of a Common Scientific and Technological Space in the CIS would contribute to innovation processes in the region, building on the new forms of institutional cooperation made possible by the Customs Union and EurAsEC. A good example of the possibilities created by these links and successful cross-border cooperation in the region between scientific research institutes, universities and private non-commercial organizations are the programmes of the Union State of Russia and Belarus.[102]

There are various dimensions to the opportunities to exploit the innovative potential of economic integration within the CIS and EurAsEC (table 28):

[102] One concrete illustration is “BelRosTransGen”, in the framework of which successful experiments with genetically modified species were carried out in 2010 as well as biological products derided from them. It is envisaged that the results will be used for production of special foods as well as medicines and cosmetics.

Table 28. Potential international policy actions to promote innovation, CIS and EurAsEC

Dimensions	Possible internationally-agreed policy instruments and interventions
I. Resources	
1.1 Human capital	Staff mobility schemes for education and teaching, R&D, industrial projects.
1.2 Scientific research infrastructure	Sharing equipment within specially created joint laboratories; Virtual networks of libraries and databases of scientific information; Online and physical access to depositories of scientific materials and samples.
1.3 Investments	Internationally coordinated state loans and state guarantees for bank loans; Tax credits for R&D expenditures of SMEs acting as joint ventures or performing joint R&D projects.
II. Market potential	
2.1 Demand from industrial enterprises within the CIS	Policy measures to stimulate demand for R&D by enterprises from other CIS countries; Joint ventures with a common R&D department.
2.2 Critical mass for attracting transnational corporations in R&D	Virtual laboratories with real-time on-site telecommunication opportunities for the performance of large-scale R&D for domestic and foreign TNCs.
2.3 Introducing science-intensive and high-tech products and services to foreign markets with high entry barriers	Alliances of innovative enterprises (SMEs or SMEs with large enterprises) for sharing the patenting and marketing expenditures of science-intensive and high-tech products and services abroad; Policies to facilitate the establishment of joint technical service points and the collection of customer orders from abroad; Cross-border fixed investment in the creation of assembly lines and joint production facilities.
III. Institutional potential	
3.1 Innovation infrastructure	Cross-border networking among technoparks and technology transfer centres; Joint technology transfer centres servicing several countries; Cross-border networks of business-angels and venture capitalists.
3.2 Intellectual property institutions	Cross-border networks of centres addressing intellectual property issues in joint research, educational projects, consultancy for innovative SMEs.
3.3 Legal protection	Coordinated policies on innovation vouchers for SMEs, patenting and innovation-related consultancy services and legal representation abroad

Opportunities and challenges of cooperation with EU and other countries

Cooperation with the more technologically advanced EU countries offers potential benefits for innovation in Belarus. In the private sector, subcontracting and mergers and acquisitions are major instruments to develop this potential. Subcontracting facilitates access to organizational "know how", and the sharing of technical expertise in areas of mutual commercial interest. The acquisition of small scientific and technical firms by larger companies provides access to additional financial and technical resources and new networks. All these forms of technological integration involve positive externalities in the form of knowledge spillovers. Linkages between domestic and foreign companies can contribute to the diffusion of technologies.

The European Research Area created new possibilities for external countries to access EU technical expertise. The EU has increased opportunities for Belarusian scientific organizations and universities to participate in international projects, sometimes with particular funding conditions tailored specifically for Belarus (e.g. the involvement of Belarusian partners in some FP7 projects is a necessary condition for a project to be approved). Public and private foundations encourage applicants from Belarus and provide financial support for scientific and educational mobility of Belarusian students and researchers in the EU.

However, as discussed earlier, there are also a number of barriers and impediments that prevent innovation stakeholders in Belarus from realizing the full benefits of this cooperation potential. Weak institutional and economic capacity is a major constraint. Such weaknesses, for example in terms of marketing or IP management capacities, can lead to inexperienced enterprises and institutions missing profitable opportunities. Appropriate advisory services need to be developed for legal support and assistance with developing commercialization strategies, particularly for SMEs.

Another potential risk is that facilitating cooperation and encouraging mobility measures may lead to some researchers leaving the country permanently. While intellectual migration is a natural process, a "smart" innovation policy should seek to turn this threat into an opportunity for acquiring international expertise from returning researchers, and a driving force for the modernization of domestic industries and increased international competitiveness.

The feasible set of policy instruments for fostering cooperation in innovative development with the EU is similar to that for the CIS countries. However, given the disparities in the resource base and informational asymmetries, special emphasis should be placed upon the systemic support of research staff mobility schemes, legal representation of the interests of Belarusian innovative enterprises in the EU, consultancy and assistance in intellectual property issues, including joint patenting and licensing.

7.5 Recommendations

Belarus is a small open economy for which success in external markets is a necessary dimension of its innovation performance. However, internationalization is a significant challenge for companies and should be supported by policy initiatives facilitating international trade in science-intensive goods and technologies. In particular, special attention

needs to be given to export-oriented SMEs, for which the barriers to trade are most significant.

Recommendation 7.1

The authorities should encourage the internationalization of companies engaged in knowledge-intensive activities. This strategy should include not only measures to promote exports but also to facilitate access to imports, as these are a channel for the diffusion of innovation. The authorities should consider:

- *Addressing certification, standards and similar barriers that can restrict trade;*
- *Using the state order system (procurement) as a testing platform for innovative technologies at their early-stage of development, as prior step to the beginning of international operations; and*
- *Providing support to SMEs to develop their competencies in international marketing, intellectual property management and other relevant aspects when seeking to enter foreign markets.*

Recently, a number of new initiatives have promoted broader and deeper economic cooperation within regional integration structures such as the CIS and EurAsEC. Such initiatives provide a nurturing ground for closer cooperation in science and technology and joint innovation projects. The potential for this type of cooperation is reinforced by shared history and language, a common scientific and education legacy and traditionally strong economic linkages. Institutional and personal contacts with organizations and researchers in other CIS countries are another source of strength that must be nurtured.

Recommendation 7.2

The authorities should take full advantage of the potential of integration processes in the CIS to foster scientific and innovation capabilities through appropriate initiatives, including at the institutional level by undertaking practical steps such as:

- *Initiating international agreements on the sharing of S&T resources for innovation activities such as sharing of equipment, establishing joint laboratories and virtual networks of libraries and databases of scientific information, materials and samples;*
- *Promoting further initiatives for the creation of international scientific research centres, following the model of the International Innovation Centre of Nanotechnologies of the CIS countries; and*
- *Initiating an international policy dialogue on the establishment and further development of common innovation support schemes and programmes providing financial support for the undertaking of international S&T and innovation projects within the CIS or EurAsEC.*

The institutional framework for international science and technology collaboration has been gradually developed in Belarus over recent years, through the efforts of the public authorities and other innovation stakeholders. However, there is not yet an integrated strategy for

international cooperation that duly emphasizes the international dimension of innovation processes. In addition, effective international cooperation calls for a wide participation of innovation stakeholders, supported by dedicated structures. Public efforts can play an important role in helping the various actors in the national innovation system overcome the coordination, financial and organizational hurdles that prevent stronger interaction with potential foreign partners.

Recommendation 7.3

The authorities could consider developing an integrated and coordinated strategy for international science and technology cooperation that complements existing policies and targets different components of the national innovation system. The following measures could be part of this effort:

- *Designing and putting in place measures stimulating forms of international cooperation in science and technology with significant positive effect on domestic innovation capabilities;*
- *A specialized Agency or Office for International Science and Technology Cooperation could be a useful instrument to oversee the implementation of the integrated strategy; and*
- *Providing targeted support to innovation stakeholders to develop and increase their international networking activities, in particular regarding foreign technoparks, technology transfer centres and educational institutions.*

There are a range of existing possibilities for scientific international cooperation which depend on successful applications for technical aid. However, this potential has yet to be fully realized due to shortcomings in capacity and the lack of appropriate incentives to engage in this type of activities.

Recommendation 7.4

The possibilities offered by technical aid in support of scientific international cooperation should be used more extensively. The national approval procedure should be simplified and could eventually be abolished. In addition, the authorities should create better conditions and incentives to make active use of technical cooperation possibilities by:

- *Providing support to research organizations to develop the necessary skills to foster international cooperation, including addressing language barriers;*
- *Introducing adequate compensation for the preparation of good quality project/funding applications, irrespective of outcome; and*
- *Introducing tax rebates and exemptions for R&D activities, including on the income accruing to researchers for small projects.*

International mobility of Belarusian scientists and their active participation in international projects are essential in ensuring that they keep abreast of the latest scientific innovations and develop the personal and institutional networks through which scientific knowledge is

disseminated. Belarus has made important efforts in creating institutional relations with foreign partners but continued attention in this area is required, in particular in terms of facilitating links between personnel. Student mobility also constitutes an important element of knowledge-sharing and the generation of new ideas. At the same time, permanent migration of scientists abroad may have negative implications for domestic scientific capabilities. Policies should recognize this potential downside and adopt measures that increase the net benefit of international mobility.

Recommendation 7.5

In order to encourage the participation of Belarusian scientists and students in international knowledge and networks while preventing a "brain drain" there is a need to strike a delicate balance in policy initiatives. To this effect the authorities could:

- *Provide effective support and incentives for the participation of research personnel in international projects, and strive to simplify all associated procedures;*
- *Facilitate participation in conferences, study opportunities and internships abroad;*
- *Introduce incentives encouraging the return of scientists from abroad and ensuring the adequate reward of domestic talent, through appropriate career and pay incentives;*
- *Put in place schemes that seek to facilitate the preservation of contacts with Belarusian scientists who have migrated abroad, and facilitate communication with them.*

Annex

PROSPECTIVE INNOVATION-DRIVEN INVESTMENT PROJECTS AND INFORMATION SOURCES

The aim of this annex is firstly to introduce the main sources of information available to prospective investors in Belarus and secondly to present and discuss a number of actual and potential investment projects with a clear innovative character. Belarusian policy documents outline those areas that are considered as a national priority for further development.

In principle, the current economic situation in Belarus is a potential source of investment opportunities that may be attractive to investors. The "catch-up" process is typically associated with a period of relatively high GDP growth. Belarus is endowed with a well qualified work force, sound transport infrastructure and close proximity to the large EU and Russian markets.[103] Membership of the Customs Union with Kazakhstan and the Russian Federation has increased the attraction of Belarus as an investment location.

This annex first identifies areas that have been the focus of particular policy attention, as evidenced by declared policy priorities, including those listed in the State Programme for Innovative Development for 2007-2010 and the draft State Programme for Innovative Development for 2011-2015. In accordance with the declared national priorities, public policy seeks to achieve concrete breakthroughs in these sectors and, accordingly, they are more likely to generate innovative investment opportunities. In addition, the annex presents various information resources on potential innovative investment opportunities in the public and private sectors and a number of recent and potential investment projects of an innovative character.

1 Priority focus areas for innovation activity

The priority areas for innovation policy indicate fields in which state support and investment opportunities are likely to be strong. Recently, the priority directions of scientific and technical activity in Belarus[104] have been:

- Energy- and resource-saving technologies for higher competitiveness;
- New materials and new sources of energy;
- Medical science and pharmacy;
- Information and telecommunications technology;
- Technologies of production, processing and storage of agricultural products;

[103] See "Investment Policy Review: Belarus", UN Conference on Trade and Development", Geneva, 2009.
[104] See "Catalogue of innovation projects and developments by organizations of the National Academy of Sciences of Belarus", National Academy of Sciences, Minsk, 2009.

- Industrial biotechnology; and
- Environmental protection and management.

These are domains in which national policymakers consider that there is an existing "critical mass" of capacity and know-how for the commercialization of innovative technologies. This is further discussed in section A.3, where the public information sources are discussed in more detail.

2 Future priorities for innovative development

The draft State Programme for Innovative Development (SPID) for 2011-2015 defines as its key objectives the creation of a globally competitive, innovative economy that is high-technology centred with a high level of resource and energy efficiency.

The aim is to create both new industries and firms, as well as to modernize existing industries (through energy-saving technologies, for example). Funding for projects envisaged in the programme is anticipated from a variety of sources, including not only budgetary financing but also loans from domestic banks, other sources of debt and equity financing, as well as foreign direct investment.

The envisaged priority areas in this new State Programme of Innovative Development include:

- Developing high-tech areas such as microelectronics, instruments, precision engineering and information technology;
- Increasing the share of export-oriented industries (automotive manufacturing, machine tool and tool industry, microelectronics, optics and opto-mechanical products, chemical products, pharmacy, etc.);
- Increasing production of consumer goods, especially household appliances and electronics;
- Increasing the sophistication of production, with enhanced supply chains;
- Improving the quality, reliability and durability of Belarusian goods, technologies and services; and
- Increasing export of high- and medium-technology to markets in Asia, China, the Middle East and other regions.

The implementation of this draft Programme will create investment opportunities, as some of the projects detailed there would require external financing for their implementation. Table 29 provides a sample of projects worth $250,000 or more, at current exchange rates, with an innovative character. The Programme is still a draft and therefore information may change.

Table 29. Selected innovative projects in SPID priority areas envisaged for 2011-2015

Project Name	Funding volume $m	Realization term, years	Executing agency
To develop minimally invasive medical technology: osteosynthesis	0.25	2011-2015	GU RSPC Traumatology & Orthopedics, NP LLC Medbioteh
Organ treatment of patients with superficial and invasive bladder cancer using photodynamic therapy	0.40	2011-2015	GU RSPC Oncology and Medical Radiology. NN Alexandrov
Treatment for chemotherapy patients' operable & metastatic breast cancer based on assessing sensitivity of individual tumours	0.70	2011-2015	GU RSPC Oncology and Medical Radiology. NN Alexandrov
Technology for use in cardiac surgery	0.40	2011-2015	GU "RSPC" Cardiology
Use of stem cell technology to produce optimal, biologically active grafts for spinal fusion in spinal surgery	0.40	2011-2015	GU RSPC Hematology and Blood Transfusion
New method for regenerative restoration of damaged cartilage in large joints	0.26	2011-2015	GU RSPC Traumatology & Orthopaedics, GU RSPC Pediatric Oncology & Haematology
"Unitechprom" BSU[i]: production of cardiotropic drug "Nitargal"	0.34	2011-2014	Institute of Physical Chemical Problems, BSU
"Unitechprom" BSU: production of pharmacological substance temozolomide for anticancer drug Temobel	0.34	2011-2015	Institute of Physical Chemical Problems, BSU
"Unidragmet" BSU: production of pharmaceutical substances based on platinum compounds for drugs Cisplatin and Oxaliplatin	0.36	2011-2015	Institute of Physical Chemical Problems, BSU
Developing technology for complex processing of flax seeds to produce antiallergenic preparations.	0.30	2011-2015	Belarusian State Technical University
Investment in sewage sludge treatment works in Slonim for biogas production and its use in thermal power sector	5.02	2006-2011	JSC Slonim Vodokanal
Munitions disposal and production of emulsion substances (up to 10,000 tons per year), including design and survey work	10.70	2007-2013	SSPA Powder Metallurgy, Clearing Centre for recycling artillery
Production process and equipment for environmentally friendly multi-purpose lubricants	0.24	2011-2013	NASB Spetssmazka
Develop new energy-saving ventilation systems for heat emissions from industrial plants and expanded production of ventilation-heating equipment, including heat recovery	3.15	2010-2013	Enterprise "Alternative"

[i] Belarusian State University.

Source: Information provided by the Belarusian Institute of System Analysis and Information Support for Scientific and Technical Sphere on the basis of the Draft State Programme for Innovative Development 2011-2015. Financing requirements estimated at an approximate exchange rate of 1 US$ = 3,020 BYR.

3 Public sources of information on innovation projects

Republican Centre for Technology Transfer (RCTT)

The RCTT was founded in May 2003 by the State Committee on Science and Technology of the Republic of Belarus, the National Academy of Sciences of Belarus, the United Nations Development Programme (UNDP) and the United Nations Industrial Development Organization (UNIDO).[105]

The RCTT plays a key coordination role in promoting the commercialization of Belarusian technological advances, including with foreign participation, facilitating the cooperation between high-technology developers, entrepreneurs and investors. The RCTT website is also a useful resource for potential investors regarding the broader legal and regulatory framework.

The "clearing house" service comprises "offers" and "requests". "Offers" are newly developed technologies or other R&D outputs with potential for commercialization which are offered to the market, typically by academic and research institutes. The "requests" for technical solutions are calls to the academic and research community for possible solutions to technical problems, typically arising in industries and hence with commercial support. The state scientific enterprises of the National Academy of Sciences have been particularly active in making use of this "clearing house". Belarusian innovative enterprises also offer their products and intellectual property for commercialization through the services of the RCTT.[106]

Technological innovation proposals, or offers, are grouped by the classifier of the European technology transfer network IRC, the classifier network of the US commercial technology transfer centre yet2.com and the classifier network of the United Nations Industrial Development Organization for ease of use for different domestic and foreign enterprises and investors.

Technology offers include a date of posting, and an indication of until when the posting will remain active, as well as an identification code for reference. There is then typically an abstract, a brief description of the technological offer, including the type of technology (e.g. device), and what the expected technical and economic benefits are, innovative aspects, current stage of development, IPR status, and "scope" of the technology (e.g. sectors and situations where it can be applied). There is also an indication of the geographical origin of the technology, and where it seeks to be marketed (e.g. domestically, internationally). The expected environmental impact of the technology in question is also indicated, as well as the form of the proposed cooperation (e.g. contracted/ licensed technology), conditions and limitations on the technological transfer and an indication of what support will be provided in the technology transfer process (e.g. technological documentation, personnel services). Offers posted on the RCTT website may also be placed on the Russian Technology Transfer Network's (RTTN) website, with which there is close cooperation.

[105] See http://ictt.by/eng/Default.aspx?tabid=1
[106] See http://ictt.by/rus/Default.aspx?tabid=332

Requests (usually by enterprises), for solutions to commercial technical problems are posted in a similar fashion (title, code, posting and expiry dates with a brief description). However, they typically contain technical specifications stipulating the solution required. Again, the type of collaboration being sought is also specified.

The main office of the RCTT is a relatively small scale operation but it has 23 branch offices located at universities, enterprises and other institutions.[107] The RCTT also plays a key role in the organization of regional innovation structures, and aims to create a unified national network of technology transfer centres.

The RCTT provides information on its website on the main public sources of innovation projects, including the catalogues prepared by the State Committee on Science and Technology and the National Academy of Sciences of Belarus.

State Committee on Science and Technology

The State Committee on Science and Technology of the Republic of Belarus prepares annually a "**Catalogue of Innovation Projects and Elaborations**",[108] which summarizes the results of state scientific, technical and innovative programmes and projects. The latest version (issue 15) is available on the RCTT's website.[109] It includes innovative projects and developments that were carried out in 2008 as part of the state scientific and technical programmes and the State Programme for Innovative Development of the Republic of Belarus for 2007-2010, as well as other projects concerning new technology, machinery and materials and other innovations.

Projects reflect the prevailing priorities for innovation policy in Belarus, as already outlined in this annex, and are grouped according to the following categories:

- Environmental protection
- Import substitution
- New patents
- Resource savings
- Waste management, use of recycled resources
- Export-oriented products.

Entries may be finished products with details of sector, programme and scope. The information includes a description of the product, assessment of scientific and technological level, readiness, expected results and means of implementation. The technical level is typically assessed in terms of current "state of the art" on the Belarusian, CIS and world markets, as appropriate. In terms of implementation, some products are for sale or order, while others are made available for collective use or as prototypes. The latter may be of interest to investors with capital to invest in commercial scale production.

[107] See http://ictt.by/eng/Default.aspx?tabid=28 for more details of branch offices.
[108] See http://ictt.by/eng/Default.aspx?tabid=104
[109] See http://ictt.by/Docs/catalog2009/catalog15/index2139.html

In other cases, entries in the catalogue may be advertising the potential for technology transfer. Products may be prototypes, or in a state such that are ready for mass production. The level of detail provided also varies. The Minsk tractor plant, for example, provides very detailed specifications, and is offering to make "deliveries under contract". So offers range from scientific and technical cooperation at a basic level, to providing a developed prototype as a basis for mass production, all the way through to final products for sale.

According to the latest catalogue, projects were distributed between domains as follows:

Table 30. State supported[110] innovative products in 2008

Domain	Number of products
1. Electronics & Information Technologies	27
2. Laser Engineering & Technologies	12
3. New Materials & Protective Coating	22
4. Tools	12
5. Mechanical Engineering, Metal Processing	25
6. Automobile & Tractor Building	12
7. Technology for Agriculture	20
8. Light & Food Industry	18
9. Instrument Engineering, Precision Tools	19
10. Architecture, Construction	14
11. Chemical Technology, Biotechnology	12
12. Agribusiness	12
13. Medical Science	20

Source: SCST, Republican Centre for Technology Transfer.

These data reveal areas of strength where there is a sizeable stock of products available for commercialization, for example electronics and information technologies, and mechanical engineering.

The commercialization of innovative products depends on the availability of a "critical mass" of human expertise. Table 31 shows the developers responsible for four or more products in this catalogue, either on their own or working jointly with other developers. This is one illustration of the degree of concentration of expertise in a number of the key domains for Belarusian science and technology:

[110] Here this means those realized as part of the state scientific and technical programmes, innovative projects and the State Programme for Innovative Development of the Republic of Belarus for 2007-2010. See http://ictt.by/Docs/catalog2009/catalog15/index2139.html for more details.

Table 31. Innovative outputs by origin and domain,[111] "Catalogue of Innovation Projects 2008"

Developer	No. of products [i]	Domain [ii]												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Belarusian State Tech. University	4			***4***										
Belarusian National Tech. University	15	***4***		1		***7***	***3***							
SSI[iii] "Mechanics of Metal-Polymer Systems"	8			***5***		1					2			
SSI "Institute of Microbiology"	6											1	***4***	1
SSI "Institute of Powder Metallurgy"	12	1		***4***	***6***					1				
SSI "Institute of Physics"	9		***9***											
SSI "Joint Institute of Engineering"	10			2	2		***6***							
SSI "Physical-Technical Institute"	10			2	2	***6***								
SSI "Central Botanical Garden"	4								1				1	2
Institute for meat & milk industry	18								***13***			1	***4***	
Belmikrosistemy	13	***13***												
Borisov Medical Preparations Plant	6													***6***
Minsk Research Instrument Institute	6									***6***				
Institute of Welding & Protective Coatings	7	2		1		***4***								
Belmedpreparaty	11													***11***
Minsk Automobile Plant	4						***4***							
Minsk Tractor Plant	5					1	***4***							
Centre for agricultural mechanization	20							***19***			1			

[111] See http://ictt.by/Docs/catalog2009/catalog15/index2139.html for further information. Table includes academic and R&D institutions with four or more products in the "Catalogue of Innovation Projects and Elaborations 2008", and so is not exhaustive. Domains numbered as in table 30.

Table 31. Innovative outputs by origin and domain,[112] "Catalogue of Innovation Projects 2008" *(continued)*

Developer	No. of products [i]	Domain [ii]												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Semiconductor Devices Factory	13	***12***								1				
Research Institute for Fire and Emergencies	9						2			***3***	***4***			
Institute of Physical Chemical Problems, BSU	8											***4***	2	2
"Horizon" digital television	5	***5***												

[i] Note that certain products have been developed by more than one developer, and so there may be some double counting here.
[ii] Number of projects identified by domain and developer, lower (1-2), middle (3-4) and high (5 or more) project concentrations identified.
[iii] State Scientific Institute.
Source: SCST, Republican Centre for Technology Transfer.

National Academy of Sciences of Belarus (NASB)

The NASB draws extensively upon the RCTT for support in publicizing and commercializing its products and expertise.

There is also a "**Catalogue of Innovation Projects and Development Products by the National Academy of Sciences of Belarus**", also made available on the RCTT website,[113] the latest of which is for 2009.

As with other catalogues, the information made available varies according to the product under consideration. Typical available information includes a summary of the product/ project, descriptive information, the developer's contact details and technical details regarding the type of technology. Additional information is included regarding any expertise offered (e.g. licensing, personnel, etc.), likely geographical market of application, etc. This is broadly in line with the information provided for technological "offers" on the RCTT's website.

This catalogue brings together in one place all relevant innovative outputs by the NASB and its institutes during the period in question. Particular projects may also be posted with a shorter time delay in the "offers" section of the RCTT website, where timeliness is considered essential. The catalogue has the benefit of showing the kind of technologies being developed, and in what areas the NASB has expertise of potential commercial application. It is therefore

[112] See http://ictt.by/Docs/catalog2009/catalog15/index2139.html for further information. Table includes academic and R&D institutions with four or more products in the "Catalogue of Innovation Projects and Elaborations 2008", and so is not exhaustive. Domains numbered as in table 30.
[113] See http://ictt.by/eng/Default.aspx?tabid=247

useful for an investor who may wish to contact personnel with the relevant skills, to discuss the technical viability of a potential innovation.

Table 32. Innovation projects and development products by domain, NASB, 2009

Domain	No. of projects
Agriculture, Food & Fishery Resources	51
Agro Food Technology	2
Biological Sciences	18
Education, Economics & Social Sciences	8
Electronics, IT & Telecommunications	43
Energy	17
Environment & Safety	25
Industrial Manufacturing, Material & Transport Technologies	109
Measurements & Standards	10
Other Industrial Manufacturing	24
Sciences (Chemistry, Physics, etc.)	46
Total	**353**

Source: National Academy of Sciences of Belarus.

The "**Catalogue of Products and Services Offered by Enterprises and Organizations with the National Academy of Sciences of Belarus**" is a less frequently updated catalogue of the NASB, which is also available on the RCTT website.

Published catalogues generally record what has already been achieved. Institutes and organizations affiliated to the NASB also seek support to develop new innovative projects, as in the sample shown in table 33.

Table 33. Sample of potential innovative projects by organizations of the NASB

Project	Domain	Organization (NASB)	Objective/ description	Estimated financing requirement € million
Radio Frequency Identification (RFID) technology to monitor goods flows	Logistics & e-business operations	Inter-branch Scientific & Practical Centre for Identification Systems and e-Business operations	Joint production of RFID-equipment and systems for commercial sale	5-10

Table 33. Sample of potential innovative projects by organizations of the NASB *(continued)*

Project	Domain	Organization (NASB)	Objective/ description	Estimated financing requirement € million
Development and production of environmentally safe, multipurpose plastic lubricants	Design, manufacturing & innovative enterprise	Innovation Association "Academtechnopark" with "Specsmazki" Ltd.	Joint venture for large-scale production of plastic lubricants for the food and pharmaceutical industries, urban transport and agriculture	10
Pilot building with high-energy efficiency (administrative building)	Energy, architecture & construction	Institute of Energy of the NASB	Promoting reduced energy consumption in office buildings, demonstrated by reconstruction of Institute of Energy's building	2
Production of hollow ultra filtration membranes for treatment of water from surface sources	Treatment of water from surface sources	The Institute of Physical Organic Chemistry of NASB	Successful establishment of production	15
Integrated production of composite materials	Materials, resource efficiency	VA Belyi Institute of Mechanics of Metal-Polymer Systems	Successful production using recycled materials	7
Manufacture of billets of anti-frictional silumin	Materials: low friction alloys	Institute of Metal Technology	To set up production facilities for manufacturing billets for machine parts which work in frictional units	*Stage 1:* 0.325 *Stage 2:* 8
LED streetlights and lighting services for municipal housing	Lighting	Centre of LED and optoelectronic technologies CLOT	To establish a production enterprise for technology	20 - 25

Source: Direct communication by the Republican Centre for Technology Transfer.

Ministry of Economy

The Ministry of Economy provides a web based service[114] summarizing the range of major public investment projects it has approved that are being offered by government ministries, state concerns, regional committees and free economic zones (FEZ's) that require external financing.

Investment projects are listed by project name and cost, together with an indication of the likely time frames for both the project's realization and payback. Additional information available for interested investors to consider particular projects in more detail includes a project opportunity description, progress update and a brief consideration of project history, environmental impacts and potential risks or barriers.

There is also information on financial requirements with an estimate of likely state support and the funds required from any external investor. Support available generally includes state grants, investments, state equity/ownership shares or other "in-kind" resources. Expectations of bank financing may also be indicated.

In some cases there are estimates of potential demand and revenues, against operating and maintenance costs, to give an expected annual net profit figure. When available, this information allows the calculation of the payback period for a potential investor.

These projects are often seeking foreign direct investments, which is a channel for technology transfer, thus spurring innovation. A National Investment Agency has also been established, which although in its infancy has the potential to make a valuable contribution to the promotion of FDI.

The projects advertised are varied, ranging from large scale infrastructure and construction projects to much smaller scale operations. There are also a number of innovative projects seeking funding, which reflect priorities from the State Programme for Innovative development such as increased resource efficiency (table 34).

Table 34. Sample of investment projects publicized by the Ministry of Economy

Advertising agency	Project	Project cost ($ million)	Expected implementation period (years)	Payback period (years)
Belbiopharm	Build-up of new production of solid dosage forms at the pharmaceutical factory of JSC[i] "Borisovskiy Zavod Medicinskikh Preparatov"	54	4	8.6-9.6
Belgospischeprom	New biotechnology factory	28.3	2	5-6

[114] See http://w3.economy.gov.by/ministry/bip.nsf/alleng.html

Table 34. Sample of investment projects publicized by the Ministry of Economy *(continued)*

Advertising agency	Project	Project cost ($ million)	Expected implementation period (years)	Payback period (years)
Ministry of Industry	Establishment of new and modernization of existing production, Minsk Tractor Plant, 2009-2015	427.4	7	5.1-6.1

[1] Joint stock company.
Source: Ministry of Economy.

4 Sources of information for private investment projects

Belarusian Innovation Fund

The Belarusian Innovation Fund (BIF) provides financial support to innovation-related and technical projects on the basis of budgetary resources. More information on this institution can be found in chapter 6. The BIF is also a useful resource for prospective investors. One of the BIF's priority directions is to organize exhibitions, scientific and technical fairs, seminars, conferences, symposia and other scientific and practical activities.[115] Given this role, together with the degree of over-subscription for its limited funds and regular contacts with entrepreneurs seeking financial support, the BIF is a potentially useful source of information on investment opportunities in the private sector.

Belarusian Chamber of Commerce and Industry

The Belarusian Chamber of Commerce and Industry is a useful point of first contact for potential investors in Belarus. Its website provides general information by providing links to Free Economic Zones, and more relevant legislative information such as the Investment Code.[116] It also has a network of regional branches, which may be contacted by investors interested in a particular region of Belarus.[117] There is a useful section of the website on national and state programmes of particular relevance to investors.[118]

The Chamber of Commerce and Industry provides a service whereby enterprises may advertise their investment projects.[119] The projects advertised here are displayed in a similar way to those on the Ministry of Economy's website, i.e. with expected time frame, payback period and other relevant information for investors. Projects are generally smaller in scale,

[115] See http://www.bif.ac.by/rus/businesssupport/businessplan.html
[116] Link provided to http://www.pravo.by/webnpa/text.asp?start=1&RN=HK0100037
[117] See http://www.cci.by/Default_en.aspx
[118] See http://www.cci.by/ru/chamber/Invest/program.aspx
[119] See http://www.cci.by/ru/chamber/Invest/v3.aspx

and looking for funding for capital investments in the range of $1 million-$5 million. Most projects target foreign funding sources in the form of credits or FDI.

There is also an information package of investment proposals, prepared by Belarusian enterprises, available in both English and Russian languages for potential investors.[120] Projects are again presented in a similar format to those presented on the Ministry of Economy's website. Many of these projects are advertised on behalf of ministries looking to create enterprises with external financing, or for large public infrastructure projects looking to attract external financing (e.g. construction of a hydro-electric power station, construction of power plants, etc.) Some are for small investments of as little as $1 million, but some of the projects advertised run in to the hundreds of millions of dollars. State industrial groups also make use of this service to publicize potential investment projects in plant and equipment, for example.

Informational events and resources

There is a wide range of online informational resources available to potential investors in Belarus, ranging from information on specific investment projects, and their requirements for external financing, to more general information on the legal framework. The Belarusian Institute of System Analysis (BelISA), for example, through its "Catalogue of Normative Documents"[121] provides a useful legal database of relevant legislation in the field of science, technology and innovation.
The first Belarusian Venture Fair was held in November 2010 in Minsk. Project proposals were invited, and then publicized in advance of the event on the RCTT's website,[122] where they were grouped by project region. Also held at the same time was the 2nd Belarusian Innovation Forum, which is a forum designed to bring together the key players in the innovative field and facilitate exchange of information between them.[123]

While venture capital and business incubators remain in their infancy in Belarus, there has been a recent tendency towards organized events and networks seeking to match innovative ideas with investors, both domestic and external. Investment opportunities are typically smaller in scale than those targeted for support by public institutions. An example would be the "Minsk Start-up Weekend", trialled in 2009 and run over four weekends in 2010.[124] These events tend to focus on sectors such as services (e.g. retail and leisure), and IT (e.g. web portals), where there is a growing domestic capability in Belarus, and relatively modest up-front funding can lead to a commercial product and return on investment. The development of such "networking" events to facilitate the financing of small scale investment projects is one means of stimulating innovation in the increasingly important services sector. Students and young people have also been particularly active in coming forward with business propositions in this forum. Such initiatives are one step towards the development of an enterprise culture among the young people of Belarus, highlighted in chapter 2 as a necessary step towards boosting innovation in the wider economy.

[120] See http://www.cci.by/ru/chamber/Invest/v4.aspx
[121] See http://www.belisa.org.by/ru/catalogue/
[122] See http://ictt.by/eng/Default.aspx?tabid=600
[123] See http://ictt.by/rus/Default.aspx?tabid=636
[124] See http://www.startupweekend.by/

The UNCTAD Investment Policy Review of the Republic of Belarus (2009) made the case that FDI has the potential to especially benefit the SME sector in Belarus. A number of informational resources of relevance have been made available. These include the online portal for business bel.biz, created in 2005 by the International Finance Corporation (IFC) with support from the Swedish International Development Cooperation Agency. There is also a Belarus subcontracting centre to support the development of outsourcing and subcontracting, important in many transition economies,[125] established by the Minsk Capital Association of Entrepreneurs and Employers.[126]

[125] See page 75, UNCTAD (2009) for a fuller discussion.
[126] See http://allminsk.biz

GLOSSARY

Absorptive capacity: The ability of an economy to absorb new knowledge and adapt imported technologies.

Benchmarking: Comparing performance in a certain area with that of who is believed to be the best performer.

Business environment: The economic, institutional and social environment in which businesses operate. It concerns a very wide range of dimensions, including taxation, rule of law, competition, macroeconomic performance and attitudes to risk and entrepreneurship, among many others.

Business incubator: A company or facility that provides physical space and a number of services (legal, secretarial, advisory) to new businesses, helping them through the earlier stages of their development.

Cluster: System of close links between firms and their suppliers and clients, and knowledge institutions, resulting in the generation of innovation. The group of firms includes also companies that compete among themselves.

Core research: Also known as basic research. Experimental or theoretical work to acquire new knowledge without any particular commercial application or use in view.

Externality: The effect of the actions of an individual or organization on other individuals or organizations for which no appropriate compensation is paid or received.

Foresight: In the context of innovation policies, it refers to collective and participatory exercises aimed at enhancing the coordination capabilities of national and local innovation systems.

Hidden innovation: Innovation activities that are not reflected in traditional indicators such as investments in formal R&D or patents awarded.

Imitation: Adoption (by a firm) of the results of innovation undertaken by another firm or organization.

Industrial policy: Set of policy measures and interventions that affect industrial performance through their impact on microeconomic variables. In addition to innovation policy, targeting the innovation capabilities of a country, it also includes trade and competition policies.

Innovation: In an economic context, any new way of creating economic value added, for instance, through a new production or distribution process, a new business model, a new way of organizing work, or by creating new markets or finding new sources of supply/inputs.

Innovation constituency: Organizations and institutions that implicitly or explicitly promote innovation.

Innovation governance: In a broad sense, it refers to the capacity of a country to coordinate various policy measures that affect the innovation process. More narrowly, it concerns the capacity of public services to manage the cycle of policy development and implementation.

Invention: An idea, a sketch or model for a new or improved device, product, process or system.

Intellectual Property Rights: The rights granted to individuals over the creations of their minds. Intellectual property rights usually provide the creator with an exclusive right over the use of his/her creation for a limited period of time. They encompass copyrights and rights related to copyrights; trademarks and distinctive geographical indications; patents, industrial designs and trade secrets.

Market failure: A situation in which the market does not allocate resources efficiently. This may arise due to different reasons, for example, the presence of externalities, public goods or asymmetric information.

National Innovation System: The network of agents whose activities and interactions generate, import, modify and diffuse new technology in a given country, as well as government policies, the institutional set-up and financial resources devoted to innovation and knowledge. These agents include, but are not limited to, knowledge institutions (universities, research institutes, technology-providing firms), enterprises and government departments.

Non-technological innovation: Innovations not based on the use of new technologies. Examples include business model innovations (e.g., the hub-and-spokes model of airline operations), marketing innovations (e.g., a new pricing scheme), financial innovations (e.g., the introduction of a new derivative which allows the more efficient pricing and allocation of financial risks), etc.

Open innovation: Innovation process characterized by collaborative research and sharing of knowledge and intellectual property among various institutional agents.

Policy mix: Combination of various policy instruments in a range of intervention areas to achieve certain objectives.

Process innovation: Generation of new or more efficient processes of production, organization, management, distribution and marketing.

Product innovation: Generation of new or improved goods (e.g., consumer goods, equipment, materials) and services.

Public goods: Goods or services that can be consumed by anybody without decreasing the amount available to other consumers. At the same time, it is not possible to exclude specific consumers from enjoying these goods. Typical examples are defence or clean air.

Public-private partnerships: Innovative forms of joint ventures, typically involving the mobilization of financing which result from the collaboration between the public and private sectors. Many different arrangements are possible, with the public sector being either a source or a beneficiary of the financing provided.

R&D (research and development): Activity undertaken for the purpose of searching for, discovering, inventing, experimenting, imitating or developing new products (including improved versions or qualities of existing products), or new or more efficient processes.

Science: A set of methods to describe and interpret observed and inferred phenomena, past or present, and aimed at building a testable body of knowledge open to rejection or confirmation.

Spin-off: A new business entity established by an existing legal entity. There are corporate and university spin-offs. A corporate spin-off is a divestiture by a corporation of a division or subsidiary issuing to stockholders stock in a new company set up to continue the activities of the division or subsidiary. A university spin-off is the creation of a company by members of a university research group to commercialize some of the research results of the group.

Start-up: A recently-formed business venture in its earliest stage of development (i.e. before an initial public offering or acquisition), typically in a high-technology line of business.

Strategic intelligence: Information gathered in order to facilitate making plans for the future, in particular long-term decision-making, and improve current practices.

Technological innovation: The introduction of a technologically new product or process or a significant technological improvement of an existing product or process.

Technology: Relatively formal and systematic body of knowledge of techniques used for producing, distributing and transporting products, and the embodiment of this knowledge in an operating system using physical production equipment. Nowadays technological knowledge has very strong scientific content.

Technology frontier: The range of output combinations that can be produced from a fixed set of inputs with the best technology available. On this frontier, all things being equal, increases in the amount produced of one good with given resources can only be obtained by reducing the output of another good.

Technology gap: Differences in technologies (in particular, between their efficiency levels) used by two countries or companies, where one is more advanced than the other.

Technology park: Territorially defined area containing a group of (mostly start-up) companies that devote the bulk of their activities to R&D and share common facilities and infrastructure. These parks usually result from a policy decision by a government body, which provides some of the facilities at below-market prices.

Technology transfer: Exchange or sharing, usually on a commercial basis, of knowledge, skills, processes, or technologies across different organizations or countries.

Value-chain: A chain of activities through which products pass to gain some value at each stage.

Innovation Performance Review

The Innovation Performance Review contains the findings of a participatory policy advisory service undertaken at the request of the national authorities. It considers possible policy actions aimed at stimulating innovation activity in the country, enhancing its innovation capacity and improving the efficiency of the national innovation system.

This publication is part of an ongoing series highlighting some of the results of the UNECE Subprogramme on Economic Cooperation and Integration. The objective of the Subprogramme is to promote a policy, financial and regulatory environment conducive to economic growth, knowledge-based development and higher competitiveness in the UNECE region.