Univerzitet „Union-Nikola Tesla“ u Beogradu
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STRUKTURNE PROMENE I RAZVOJ

Monografija

Urednik
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REFLECTIONS ON THE EU INNOVATION EXPERIENCES: CONCEPTS AND PROPOSALS FOR BELARUS AS AN EU'S EASTERN PARTNERSHIP COUNTRY

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Abstract: *Reflections on EU's Innovation Experiences: Concepts and Proposals for Belarus as an EU's Eastern Partnership Country*

The purpose of this paper is to present and develop specific principles and to provide appropriate guidelines related to the preparation of the most important potentials in the organizational development of the national innovation system in Belarus.

National Innovation System in Belarus has a number of strengths and weaknesses. The prevailing innovation patterns of Belarus enterprises (investment mainly in acquisition of equipment and upgrading of skills) and an insufficient level of production of knowledge (R&D and patenting activity) point to some weaknesses of the innovation system and a number of gaps which need to be addressed in the future. In Belarus there have been falling investments in R&D as compared to appropriate cost of patent actions. Therefore Belarus ranks should improve in the area of streamlining and exercising development of patents. The Belarus economy has concentrations of employment and production in a number of sectors including especially manufacturing industry which accounts for more than 33% of the GDP, agri-business, machinery and component production, chemicals, petroleum, electricity, wood and furniture industry. Nonetheless, it should also be noted that the contributions of overall employment generated by medium and high technology manufacturing enterprises and high-tech services in Belarus are both substantially below the EU-28 levels.

In terms of composition, this work is so structured that after the introductory part matter is written to present some relevant experiences of the EU and experiences of Belarus as a cooperating country.

Authors proceed from an assumption that the proposed innovation models are certainly feasible and can be adapted especially in dynamic and emerging economies such as the Belarusian. In this way, especially small and medium-sized enterprises that strive to become competitive in the market and financially would then have better infrastructure for development.

Detailed reviews of innovation activities were created as well as models for the future innovation of this growing economy. Finally, the paper aims to help creators of innovation policies in practice to more easily access the proposed operational solutions for managing effectiveness of innovation system through linkages and co-ordination between its key components.

Key words: *innovation models, innovation policy, council, linkages, R&D, SMEs.*

INTRODUCTION

Innovation takes place when a new or significantly improved product or service is introduced to the market (product innovation), or when a new or significantly improved production or delivery method is used commercially (process innovation), and when changes in knowledge or skills, routines, competence, equipment, or engineering practices are required to develop or make the new product, or to introduce the new process (Nonaka & Takeuchi,1995).

By product innovation the authors consider represents introduction of a new good or service in the respective market or the development of a subnstantially improved prodict or service to be rendered in relation to its potential. For example, this potential may relate to quality, user friendliness, software or supporting systems. At the same time, to be considered as innovation it should be new to the enterprise under consideration, and it is not necessarily unknown in the market. Similarly, it is not relevant if the innovation was in the first place developed by the enterprise considered or for nthat matter by any other enterprise..

Successful product innovators can be classified into 'true innovators' and 'imitators'. This considered barometer allows mensuration of 'the degree of novelty'. Therefore, in the context of this paper it is an indication of an enterprise capacity and predisposition to come up with products that are not only new to it but are also novel ino the observed market. Authentic product innovators ('genuine innovators') are those enterprises which demonstrate having introduced and brought to market novel or upgraded products or services.

In the context of this paper authors define process innovation is as practical application of novel or substantially upgraded techniques or technologies for manufacturing and supplying products or services.

The purpose of this paper is to present the current state and prospects of the development of innovative environment for doing business in the EU and the Republic of Belarus. This direction is relevant in the context of the implementation of the long-term conceptual model "Intellectual Belarus", which is aimed at enhancing and effective use of the competitive advantages of Belarus. The conceptual model is based on the principle of "overtaking

without catching up", and includes three main elements (Strategiia "Nauka i tekhnologii: 2018-2040", 2017, p.7):

- Digital technologies that form the technological core of the intellectual economy (computing resources, software, network resources);
- Neo-industrial complex based on robotisation, Internet of things, etc.;
- A highly intellectual society in which an individual need is in harmony with the needs of the society.

According to the "Intellectual Belarus" model the intellectual component of economic growth of the Republic of Belarus is planned (Strategiia "Nauka i tekhnologii: 2018-2040", 2017, p. 12) to provide in such areas as the transformation of the Republic of Belarus into IT country, the intensification of innovative co-operation between science and innovations, the increase of scientific and technical competence and the rise of staff mobility.

Innovative activity of Belarusian enterprises is determined by factors of the internal (innovation potential of enterprises) and external environment (the development of the innovation system in the country). The external environment can both create restrictions and promote innovative business development. The authors consider the innovative environment as a part of the changing business environment that determines an innovative activity of enterprises (Hrechyshkina & Samakhavets, 2019; Vemić 2017a; Vemić 2017b). We proceed from the fact that successful innovative development of Belarusian business requires the improvement of the innovative environment.

LITERATURE SOURCES ON INNOVATION OF RELEVANCE TO THE APPROACH

Scientific views on innovations (for example, Drucker (1985) and Rogers (2010) have been associated with the development of entrepreneurship in the 20th century since Schumpeter (1934). Freeman (1989) introduced the concept of a NIS (NIS), and divided continental, national and sub-national innovation systems (2002). Nelson (1993) carried out a comparative analysis of national systems of technical innovations, and considered that a wide

range of factors, organisations, and policies influence the capabilities of firms to innovate.

Authors agree with scientists, involved in innovative development issues (Fagerberg, Mowery & Verspagen, 2009; Goto, 2000; Jyrki & Raine, 2002; Sun, 2002), who emphasize the fact that only an innovative path and a knowledge economy can ensure successful social and economic development of any State. They also indicate the potential for improving performance and growth through improvements in the innovativeness of the economy, efficiency, productivity, quality, competitive positioning and market share.

This conceptual approach is supported in various countries (including the EU and EAEU) at the legislative level:

- Flagship initiatives "The Innovation Union" in the context of the Europe 2020 strategy(European Commission, (n.d.) is implemented in the EU;
- State Program of Innovative Development of the Republic of Belarus for 2016-2020(National Legal Internet Portal of the Republic of Belarus, 2017);
- Strategy of Innovative Development of the Russian Federation for the Period up to 2020 (The Russian Government, 2018);
- Concept of Innovative Development of the Republic of Kazakhstan until 2020 (Information and Legal System of Regulatory Legal Acts of the Republic of Kazakhstan, 2013).

We can single out the following Belarusian scientists who are engaged in scientific research of innovative development: Babosov (2012), Myasnikovich (2004), Nekhorosheva (2006), Nikitenko (2006), Sechko (2008),Zhukovskaya (2014).

Russian authors are also actively join to the study of the NIS to identify different areas of its development (Eremina & Demina, 2015; Golichenko, 2006; Polyanin, 2015; Suglobov & Smirnova, 2015,etc.).

Eremina & Demina (2015) point to the problem of weak interaction between science and production, as well as the contradictory goals and objectives of scientists and investors as problems of the Russian innovation system. The authors see the State as the leading link in the complex system

of relations between participants of the innovation system and consider it is necessary to participate more actively in the development of innovations.

In addition, scientists offer different directions for the development of innovative systems in various ways. Suglobov & Smirnova (2015) propose a network model that is able to stimulate the interaction of scientific, educational, industrial, and business organisations. Moulaert & Sekia (2003) examine territorial innovation models;Leydesdorff &Etzkowitz (1998, 2000) offer Triple Helix of university–industry–government relations, etc.

Among the major new directions is the open innovation model which restructures companies from a closed model to an open strategy (Chesbrough, Vanhaverbeke, & West, 2006). Chesbrough (2003) invented the term "open innovation", emphasizing that, in a world of broadly-shared knowledge; companies cannot exclusively use internal ideas and should exploit the benefits of valuable ideas generated outside their enterprise developed by customers, suppliers and other stakeholders. Open innovation is therefore defined as "both a set of practices for profiting from innovation and also a cognitive mode, for creating, interpreting and researching those practices" (Chesbrough et al., 2006, p. 286). Subsequently, Chesbrough (2011) conceived the theory of the open innovation model, elaborating the "open service innovation" model that treated the business model from an open service perspective, both for product and service delivery enterprises, and concluded that open innovation is not only a means for approaching R&D but a way of developing a business.

METHODOLOGY

The Republic of Belarus is an EU's Eastern Partnership Country. Innovations are important for the development of Belarus, as they form the basis of socio-economic reforms that will facilitate rapprochement with the EU. To determine the prospects, the authors analyzed the innovative development of Belarus on the basis of a comparative analysis with the EU countries, as well as on the basis the National Statistical Committee of the Republic of Belarus database for 2009-2018.

A comparative analysis of the innovative development of Belarus and the EU was carried out using The Global Innovation Index (GII) 2019, as well as relative indicators of the development of science and technology of

the World Bank database for 2000-2017 (research and development expenditure (% of GDP), high- technology exports (% of manufactured exports)). GII is based on Innovation Input and Innovation Output. Innovation Input is based on available resources and the conditions for innovation. The achieved practical results of the implementation of innovations are expressed through Innovation Output.

According to the National Statistical Committee of the Republic of Belarus for assessing the development of science and innovation an analysis of Belarusian research and development organisations (R&D organisations), and an analysis of the volume of scientific and technical activities of these organisations was conducted. The volume of scientific and technical activities includes the volume of scientific research and development (R&D), scientific and technical services (including the cost of activities performed by co-contractors) less accumulated taxes and fees from revenue. In addition, the indicators of the dynamics and structure of employees engaged in R&D were analysed.

Belarusian R&D organisations were researched in terms of their belonging to the public, commercial and non-profit sector, as well as to the higher education. The public sector consists of government bodies, and non-profit organisations subordinate to government bodies. Commercial organisations are organisations that manufacture products or provide services for profit. Accordingly, non-profit organisations do not concentrate on making profit. Higher education organisations include various types of institutions (a classical university, a specialised university (academy), an institute, a higher college), and R&D organisations.

To evaluate the innovative development of the Republic of Belarus, an analysis of innovatively active organisations was conducted. Innovatively active organisations include organisations that incur costs of technological innovations, i.e. organisations leading the development and introduction of new or improved products, and technological processes. Industrial organisations were analysed in further detail by the types of innovative activities, since it was revealed that these organisations have occupied the largest share in the total number of innovatively active organisations. In addition, the evolutions of the shipped and innovative industrial products were analysed.

To study the forecast indicators of innovative development, the program documents of the Republic of Belarus were analysed. In particular, these are the State Program of Innovative Development of the Republic of Belarus for 2016-2020, and the National Sustainable Socio-Economic Development Strategy of the Republic of Belarus for the period until 2030. The forecast indicators of innovative development of the Republic of Belarus for 2020-2030 were systematised on that basis.

In order to formulate proposals for Belarus, the authors study the EU Innovation Experiences based on its applicability for Belarus.

Scientific research methods (analysis, synthesis, comparative method, deduction, induction, classification, systematisation, scientific abstraction, etc.), analytical method and statistical analysis were used in the study and treatment of the material in this paper.

4. ELABORATION OF RELEVANT EU INNOVATION CONCEPTS FOR A KNOWLEDGE-DRIVEN ECONOMY

National innovation management generally requires a multi-actor structure of the NIS making policy more sophisticated. Therefore, scientific debates on managing the sector have lately clearly become more frequent. Increasingly, government policy in this area is concerned with addressing not only the elements of the NIS but also the relationships and co-operation between the different actors of the NIS that leads to a coherent innovation policy.

A major issue in most countries is that relevant policies are managed by different ministries, their departments with distinct responsibilities, objectives and support infrastructures. This is clearly seen in the field of innovations, science, SME and entrepreneurship, business and regional development, training and education. More often than not, as seen from the example of our research in Belarus, observed division of institutions becomes suboptimal for managing the main problems of NIS development. Consequently, cross-functional institutional policies demand cross-functional approaches to areas such as innovation.

Originally in 2000 European commission issued a communication on 'Innovation in a knowledge-driven economy', and more recently on the data-driven economy. Originally it took a form of the five central targets focused on strengthening member states' capacity to overcome obstacles to a more innovation-enhancing environment:

Target 1: Upgraded consistency of innovation policies

Target 2: A legal structure supportive to innovations

Target 3: Enhancement of origination and development of innovative enterprises

Target 4: Modernizing key interactive points of the innovation system

Target 5: Developing a social-economic system prone to innovations

Improved EU knowledge targets, which followed, became:

- Converging Europe into a top performer in science;
- Resolve remaining barriers that hamper innovations - for example high cost of patenting actions, disintegrated market practices, not fast enough quality standard establishment and absence of required expertise - which often obstruct dissemination of original ideas into market;
- Revolutionize the methods of cooperation between the public and private sectors, especially by bringing into action Innovation Partnerships which foster cooperation between the EU and national and regional business and institutions.

In order to implement the targets these main co-ordination mechanisms can be distinguished in the EU:

1. Strategic cooperation institutions organized at a senior-level (Finland, Ireland, and Portugal): these countries for example introduced a policy decision-making or counseling institutional structure which supersedes their line ministries.

2. Delegation of management authority to one Minister or Department, which enhanced cooperation between different ministries and institutions (UK, Sweden)

3. Founding a completely new line Ministry responsible for the whole knowledge origination and management process (Denmark).

Mentioned mechanisms ensured the main EU achievements such as the establishment of an Innovation Union, Horizon 2020, Cohesion Policy, Financial Instruments and European Innovation Council.

4.1. Explanation of Rationale for EU countries to possibly recommend fostering the 'innovation council' model

The innovation council model observed by the authors seems to perform much better in upgrading management of innovations, mainly because of this rationale:

- The essence of innovations (e.g. intensive, energetic and covering many fields) always demands the cooperation of a broad list of participants from both public and private sectors of the society. A growing number of actors are involved. Only co-ordination at a high level can be successful.
- Recent research reveals an increasing number of barometers and effective instruments applied in gauging innovation measures and instruments requiring consistency, openness and an appropriate high level public resposnibility.
- Many public programs and projects are used to support the development of innovation which means using state budgets and therefore there is an obvious requirement to ensure that these resources are spent honestly and rationally.
- As the autonomy of different regions accelerates in pace appropriate co-ordination of innovation with the regions becomes increasingly significant. This approach ensures consistent management synergy with public policy priorities.
- One of the distinct advantages of innovation area if that its policy either directly or indirectly relates to all other policies. It clearly derives from this statement that there does not exist one single institutional structure which can manage the whole innovation spectrum.

The main reasons for EU countries to introduce the 'innovation council' model are elaborated in more details with the following four examples. Besides the Enhanced European Innovation Council (EIC), a pilot which supports top-class innovators, entrepreneurs, small companies and scientists with bright ideas and the ambition to scale up internationally several EU member countries formed their own innovation and/or research councils. Following are four examples elaborated by the authors.

4.1.1 The Netherlands

The Dutch research council is the national research council of the Netherlands. Established in 1950, it is responsible for funding the majority of leading scientists at this country's universities and institutes. It manages the progress of science in the Netherlands through appropriate subsidies and scientific-research programmes. It is entrusted with popularizing quality and innovations in science. In order to improve the competitive position, it was suggested to form one more organisation in this area. That is why the Advisory Council for Science, Technology and Innovation (AWTI) was formed in 2014 to advise the Dutch government and parliament on policy in the areas of scientific research, technological development and innovation. The AWTI provides advice when it is applied for or when the council deems it necessary. It enjoys an independent position towards the ministers and their departments, as well as towards other parties involved. Every year the AWTI makes an overview of the advisory topics for that period in the AWTI work programme. The AWTI focuses on knowledge development, technology and innovations, on the related policies and the factors that influence these processes (Davenport & Prusak, 1998). Often the AWTI will advise on the preconditions for knowledge development and innovations. For example on the financing of research institutes or the number of women working in science and R&D. The council also advises on the social and economic consequences of science and technology. The advisory council consists of a maximum of 10 members, each originating from different sectors of society, such as research institutes and trade and industry. The members do not represent any special interests

4.1.2 Finland

Structural changes in the wood- and paper industry mainly caused by technical change and a corresponding reduction in the labour force in the industry made it necessary for the Finnish government to pursue new avenues. The Fins have been very successful in following a diversification strategy. While wood processing and paper accounted for 75% of export in 1960, 30 years later this figure was 40% of a much large export volume and was followed closely by the rapidly expanding metals, engineering and electronics sector. According to recent development trends in Finland, wood processing and paper industry accounts for a lesser share in GDP. Awareness about the significance of the place of science, research, technology and innovations in Finland's economy can be portrayed with the fact that the R&D share in GNP jumped from 1.2% in 1985, 2% in 1992 and then to 3,5 currently. Therefore, as a result of this, Finland has consequently become one of the leader EU members in terms of in GDP growth.

Some 25 years ago The Science &technology policy council has been established in Finland. This institutional structure is a counselling authority for the government on topics important for science, research, technology and innovation areas. The Prime minister personally heads the council and of 5 other ministers and 10 senior-level expert members also constitute its structure.

The Science &technology policy council (Finland, 2019) has an executive committee, a subcommittee for Science policy as well as a sub-committee for technology policy. The latter two Committees are co-chaired by the minister for education and science and the minister for Trade and industry. The secretariat of the science and technology committee is composed of two full-time chief planning officers. The council appoints them for a three years' period. The Finnish Science & technology secretariat assists the council of the State in matters relating to science, technology and innovation and has been officially received the following responsibilities:

- to steer science and technology policy and develop its international competitiveness and share with the council useful plans and projects;
- to manage the complete the development of scientific research and education, involving appropriate plans and projects of the council of the State, and monitor research activities in related fields;

- to coordinate and evaluate measures taken to introduce and disseminate develop new technologies from Finland, resolving any management problems therein;
- to coordinate and manage participation of Finland in international scientific, research and innovation relations;
- prepare and distribute appropriate reports to line ministries on public resource usage in the scientific field;
- to initiate and manage legal projects relating to research, dissemination and implementation of new technologies;
- to initiate and propose relevant policy and implementation measures under the responsibilities of the Council.

4.1.3 Ireland

Ireland started its industrialisation by creating a large tax-free zone at the Shannon Airport. It was one of the first tax-free zones in Europe and proved to be very successful. As a second step a large effort was made in the educational system to teach information, technology and software. Following this effort innovation became the major policy line. Ireland exercises a split management model where one institution finances industry-directed strategic R&D (department of enterprise, trade and employment), while the other department finances basic research (department of education and science). The cabinet committee on science and technology, chaired by the prime minister, makes decisions on national science and technology priorities and budget estimates for science and technology. Establishment of a research council and the design & crafts council of Ireland ought to be seen in this context. Other main organisations in Ireland include Science Foundation Ireland (SFI), Irish Research Council for Science, Engineering and Technology (IRCSET) and Irish Research Council for Humanities and Social Sciences (IRCHSS) under the Department of Education and Skills.

4.1.4 Portugal

The institutional machinery for management of innovation policy in Portugal involved a large number of actors shared amongst six ministries including the Ministry of economy, The Ministry of education, the Minis-

try of labour, the Ministry of agriculture, the Ministry of social affairs and the Ministry of science and technology. The two most important institutional plays in Portugal are the Ministry of the economy and the Ministry of science and technology. In the previous development phases co-operation between these two ministries has not produced sufficient outcomes. There was a clear division of responsibilities and the Ministry of economy concentrated on the business world, while the Ministry of science coordinated scientific research activities and development of a scientific culture in society. When the Portuguese Programme for innovation (PROINOV) was set in motion in 2002 it was normally the intention to streamline a new process of increased inter-ministerial cooperation, since the creation and implementation of PROINOV was assigned to a special organizational structure entitled PROINOV cabinet, headed by the Prime minister's office. In other words, the whole structure of Portuguese innovation policy was precisely entrusted with the most senior office in governmental. This was seen as a very substantial undertaking, after similar processes implemented by other EU members. Obviously, with this move Portugal has recognized innovation policy as a critical precondition of its overall sustainable development.

Early on in the process Portugal has recognized the weakness of its innovation policy co-ordination which became a barrier for better innovation results in this country. Setting in motion of its program "PROINOV", entrusting the prime minister's office co-ordination of innovation policy altered the environment in this country significantly. It was realized that the complex and systemic character of "PROINOV" required highest-level management initiatives in order to guarantee co-operation between line ministries and make an impact of adopted Policy. More specifically, a light project co-ordination structure was created at the presidency of the council of ministers to provide technical support for inter-ministerial co-ordination as well as to implement the 'horizontal' initiatives included in the PROINOV programme. Setting in motion of the " PROINOV" was planned to be accompanied, at the technical level, by an multy-ministery committee, involving a special envoy of the Prime minister and all participating minister. It was decided for this initiative that occasional sessions meetings of the council of ministers will be scheduled to evaluate the results of imple-

mented Portuguese innovation policy, and to decide on any management interventions which may be required in this area.

In addition the National Innovation Agency (ANI) is an intermediary body that is helping to shape the alignment of R&D, innovations and technology-based entrepreneurship policies in the areas of science and economy. ANI concentrates on promoting the enhancement and transfer of knowledge, in particular through increased and better collaboration between enterprises and the R&D organizations.

5. INNOVATION DEVELOPMENT AND TENDENCIES IN THE REPUBLIC OF BELARUS

One of the indicators that allow us to assess the level of innovative development of Belarus and compare it with the EU countries is the GII. In 2019, the GII was compiled for 129 countries. Table 1 shows the GII for Belarus and the EU countries.

Table 1. GII-2019 for the EU countries and Belarus

Economy	GII 2018 rank	GII 2019 rank	Output rank	Input rank	Income
Austria	21	21	25	19	High
Belarus	86	72	95	50	Upper middle
Belgium	25	23	24	21	High
Bulgaria	37	40	38	45	Upper middle
Croatia	41	44	52	46	High
Republic of Cyprus	28	29	23	28	High
Czech Republic	27	26	21	29	High
Denmark	8	7	12	5	High
Estonia	24	24	19	27	High
Finland	7	6	7	7	High
France	16	16	14	16	High
Germany	9	9	9	12	High
Greece	42	41	54	40	High

Hungary	33	33	26	39	High
Ireland	10	12	10	20	High
Italy	31	30	29	30	High
Latvia	34	34	34	36	High
Lithuania	40	38	40	38	High
Luxem-bourg	19	15	11	23	High
Malta	26	27	20	32	High
Nether-lands	2	4	2	11	High
Poland	39	39	41	37	High
Portugal	32	32	35	31	High
Romania	49	50	53	54	Upper mi-ddle
Slovakia	36	37	33	42	High
Slovenia	30	31	30	33	High
Spain	28	29	28	25	High
Sweden	3	2	3	4	High
United Kingdom	4	5	4	6	High

Source: Global Innovation Index 2019 https://www.globalinnovationindex.org/gii-2019-report#

The data in Table 1 shows that Belarus rank has risen from 86th to 72th place in 2019. However, the methodology for calculating GII undergoes some changes annually, so this improvement in position is a relative. The table shows that the EU countries have significantly higher innovation development ranks than Belarus. Belarus income level was Upper middle, unlike the most EU countries. In addition, a comparison of the Innovation Input Sub-Index rank and Innovation Output Sub-Index rank for Belarus leads to the conclusion that the available resources and conditions for innovation are not used efficiently.

It is identified strong and weak indicators of innovative development of Belarus.

Strong indicators include [1]:

1 Rank of indicator is indicated in parentheses.

- Government funding/pupil, secondary, % GDP/cap (8);
- Pupil-teacher ratio, secondary (11);
- Tertiary enrolment, % gross (11);
- Graduates in science & engineering, % (6);
- Applied tariff rate, weighted avg., % (15);
- Females employed w/advanced degrees, % (1);
- Utility models by origin/bn PPP$ GDP (10);
- ISO 9001 quality certificates/bn PPP$ GDP (14);
- ICT services exports, % total trade (19);
- Mobile app creation/bn PPP$ GDP (6).

Weak indicators include:

- Regulatory quality (113);
- Rule of law (112);
- Global R&D companies, avg. exp. top 3, mn US$ (43);
- GDP/unit of energy use (99);
- Domestic credit to private sector, % GDP (104);
- Microfinance gross loans, % GDP (81);
- JV-strategic alliance deals/bn PPP$ GDP (100);
- Computer software spending, % GDP (107);
- National feature films/mn pop. 15-69 (105);
- Printing & other media, % manufacturing (90).

Based on this, it is clear that the most problematic are such sub-pillars, as Regulatory environment, Credit, Innovation linkages, and Creative goods and services. The strongest are such sub-pillars, как Education, Tertiary education, Knowledge workers, and online creativity. Further innovative development of the Republic of Belarus should be aimed at maintaining and strengthening strong indicators and finding ways to strengthen weak indicators by adapting to changing market conditions, increasing the competitiveness and innovativeness of products, and improving the innovation policy and investment attractiveness of the country.

Dynamics of science and technology development indicators is also provided in the World Bank database. In Belarus compared to the EU Research and development expenditures have been significantly lower than in the EU (see Figure 1) and tend to decrease.

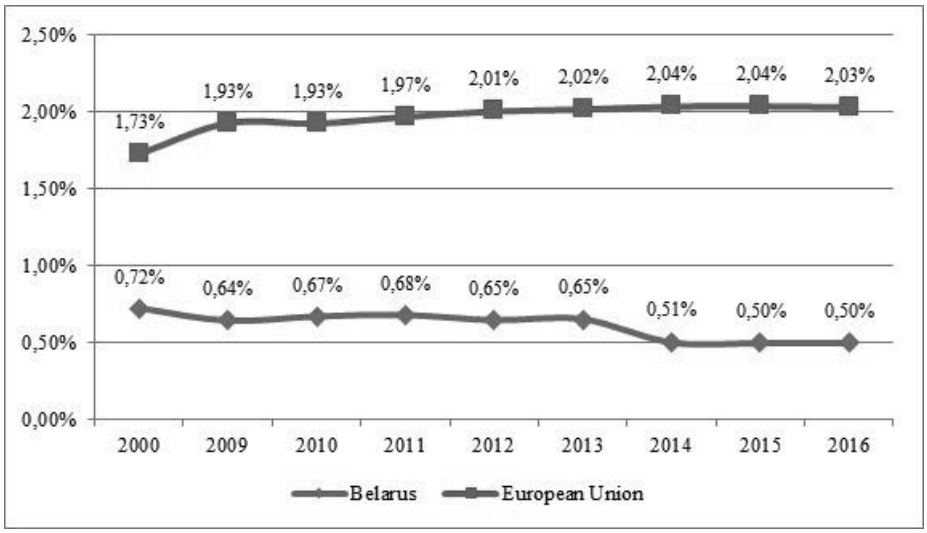

Figure 1. Dynamics of Research and development expenditures (% of GDP)

Source: Research of the authors based on the World Bank https://databank.worldbank.org/reports.aspx?source=2&country=BLR#

According to the World Bank, the high-technology exports indicator in Belarus is significantly lower than in the EU (see Figure 2), which points out a significant gap in the innovative development of Belarus from the EU countries.

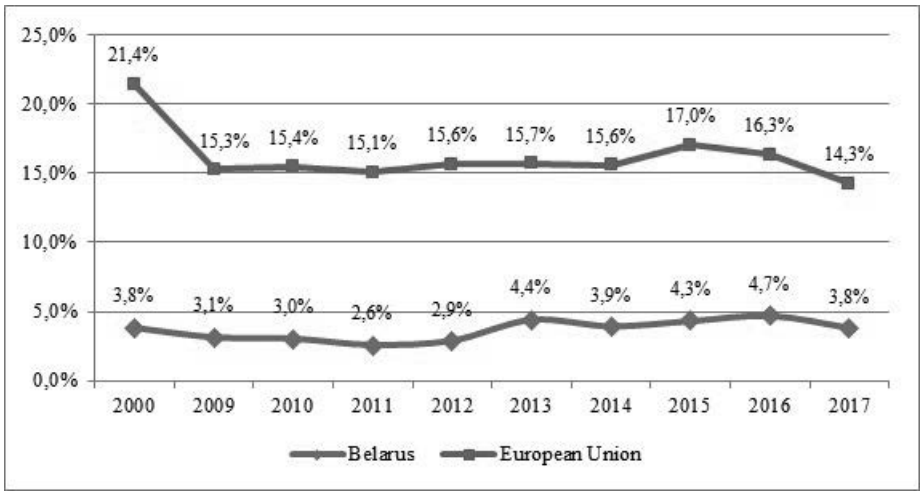

Figure 2. Dynamics of high-technology exports (% of manufactured exports)

Source: research of the authors based on the World Bank https://data-bank.worldbank.org/reports.aspx?source=2&country=BLR#

In addition, on the basis of official statistical indicators of the innovative development of Belarus (http://www.belstat.gov.by/en/ofitsialnaya-statistika/social-sector/science-and-innovation/), the following trends in the development of science and innovation can be identified:

1. The total number of R&D organizations actually increased slightly from 2009 to 2018, by 9 units (2.0%), and amounted to 455 units. Of these, 90 organizations (19.8%) were public, 287 organizations (63.1%) were commercial, 2 organizations (0.4 %) were non-profit, and 76 organizations (16.7%) carried out their activities in the higher education system.

2. The number of R&D employees decreased by 5030 people (by 15.5%) for the period 2009-2018 and amounted to 27,411 people, including 627 doctors of sciences (2.3%) and 2864 candidates of sciences (10.4 %). In 2018, 24.8% (6,792 people) of the staff was employed in the public sector, 64.6% (17,694 people) of in the commercial sector, and 10.7% (2,923 people) in the higher education system.

3. Internal R&D spending increased significantly during 2009-2018, including by BYN 264.0 million (55.5%) for 2016-2018, and amounted to

BYN 739.3 million. Internal R&D spending consisted of 93.2% of current cost (BYN 688.9 million) and 6.8% of capital cost (BYN 50.5 million). The structure of Internal R&D spending by sectors was presented as follows: in the public sector BYN 160.1 million (21.6%), in the commercial sector BYN 508.2 million (68.7%), and in the higher education BYN 71.0 million (9.6%). Internal R&D spending was mainly concentrated in the field of technical sciences (71.9%) and natural sciences (14.9%).

4. Financing of internal R&D spending in 2018 was mainly from budget funds in the amount of BYN 301.9 million (40.8%), and from its own resources in the amount of BYN 217.3 million (29.4%). Foreign investment, including foreign loans and borrowings, amounted to BYN 97.4 million (13.2%). Budgetary funds were allocated mainly to agriculture, forestry and fisheries (52.3%), own funds to industry (76.9%), and funds of foreign investors for professional, scientific and technical activities (17.5%).

5. The volume of scientific and technical activities of the R&D organisations increased significantly in 2009-2018, including by BYN 168.5 million (28.2%) for 2016-2018, and amounted to BYN 765.1 million.

6. The number of innovatively active industrial organizations increased by 146 units (by 62.4%) and amounted to 380 organizations. Their share in the total number of industrial organizations amounted to 23.3% in 2018.

7. Shipped innovative own production at actual selling prices, net of taxes and fees calculated from revenue, has increased many times over the study period, including by BYN 5,710.9 million (by 54.6%) for 2016-2018 and amounted to BYN 16,171.0 million. The share of shipped innovative production in the total number of shipped industrial production increased by 7.7% in 2009-2018 and amounted to 18.6%. Meanwhile the share of innovative production new to the domestic market in the total volume of shipped innovative production amounted to 55.2%, and new to the world market 1.2%.

According to the experts (Innovatsii dlia ustoichivogo razvitiia, 2017, p. 174) Belarus has already provided a framework for the integration of education, science and innovations (the so-called "Knowledge Triangle") in order to commercialise scientific and technical R&D and develop innovative products. Experts (Innovatsii dlia ustoichivogo razvitiia, 2017) note the orientation of the NIS of the Republic of Belarus to State support for new high-tech enterprises and increase their productive capacity. However, the effect is not

yet expressed in comparative indicators of their development. At the same time, the new high-tech companies (so-called "gazelles") are fast-growing, and they are in the early stages of internationalisation.

However, there are also problems in the areas of legislation, organisation, staffing and access to finance. It is recommended (Innovatsii dlia ustoichivogo razvitiia, 2017, p. 143) to take the following measures to eliminate them:

- Empowering academic mobility;
- Creation of scientific, educational and production centres, complexes, and consortia;
- Improvement of additional education for adults on innovative development;
- Creation of a modern legislative base, which will ensure the activity of business incubators;
- Expansion of ties between the Republic of Belarus and the European Research Area;
- Promotion and increase the prestige of teachers and researchers work;
- Consolidation of young professionals in the scientific and pedagogical staff institutions;
- Introduction and development of financial mechanisms for export lending and leasing.

In general, therefore, the analysis reveals a relatively low innovative activity of organisations in the Republic of Belarus, their technological backwardness, which is the reason for the poor competitiveness of Belarusian products in foreign markets.

6. STRATEGIC APPROACHES FOR INNOVATIVE DEVELOPMENT OF THE REPUBLIC OF BELARUS

The State Program of Innovative Development of the Republic of Belarus is the main document on the implementation of the strategic directions of the public innovation policy (Table 2). It is formed for a five-year period and focused on achieving the priorities of socio-economic development of the Republic of Belarus for 2016-2020 in the field of effective investments and accelerated development of innovative sectors of the national economy.

Table 2. Evolution of available State Programs of Innovative Development of the Republic of Belarus

Characteristics	State Program of Innovative Development of the Republic of Belarus for 2011-2015	State Program of Innovative Development of the Republic of Belarus for 2016-2020
Qualitative parameters		
Objective	Creation of a competitive, innovative, high-tech, resource-and energy-saving, and green economy	Quality growth and competitiveness of the economy
Main goals	Fundamentally new high-tech and knowledge-intensive sectors of the economy Growth of value added in production Material, energy and import intensity reduction and environmental safety of production Favourable conditions for technological development of the economy and attracting investment Market development of scientific, technical and innovative products Acceleration of regional innovative development International innovative society	Accelerated development of high-tech sectors of the economy, based on V and VI technological modes Implementation of high technologies to traditional sectors of the economy Strengthening the position of Belarus at the markets of high- tech production Development and improvement of the NIS
Quantitative parameters		
Number of projects on the creation of new industries	63	105
Financing of projects on the creation of new industries, BYN million	5,771.1	19,701.0

Source: research of the authors based on the (Council of Ministers of the Republic of Belarus, 2018; National Legal Internet Portal of the Republic of Belarus, 2017)

Therefore, the State Program of Innovative Development of the Republic of Belarus for 2016–2020 is a logical continuation of the previous one. Moreover, the volume of projects financing on the creation of new industries, which are crucial for the innovative development of the Republic of Belarus, increased by more than 3 times. The development strategy of the Republic of Belarus consists in synthesis of implementation of technologies of V and VI technological modes (Table 3), and innovative development of traditional sectors of the economy.

Table 3. Evolution of the V and VI technological modes

Characteristics	**V technological mode**	**VI technological mode (forecast)**
Stage	1970-2010	2010-2060
Key industries	Electronics; Microelectronics information technologies; Genetic Engineering; Software; Telecommunications; Space exploration	Nano- and biotechnologies, nanoenergy, molecular, cellular and nuclear technologies, nanobiotechnologies, biomimetics, nanobionics, nanotronics, and other nanoscale productions; New medicine, household appliances, types of transport and communications; use of stem cells, engineering of living tissues and organs, reconstructive surgery and medicine
Main factor	**Microelectronic components**	
Achievements	Individualisation of production and consumption	Individualisation of production and consumption Sharp decrease in power and material consumption Construction of materials and organisms with predetermined properties
Humanitarian advantages	Globalisation Acceleration of communication and movement	Significant increase in human and animal life expectancy

Source: Classification of the authors based on the International Forum of Technological Development (2018)

According to the legislation of the Republic of Belarus (State Committee on Science and Technology of the Republic of Belarus, 2017) technological mode is the complex of technologically related industries which correspond to a certain level of social production development (the crux of the envisaged technological mode). The most significant key ingredient in the creation of the Belarus technological mode is the design and formulation of specific technological directions.

The V technological mode of the Republic of Belarus incorporates technologies in the following technological areas: information and communication technologies (ICT); biotechnology; technology micro-electronic technologies; technologies related to robotics and engineering of new instruments; new computing technologies, fiber-optic apparatuses, new technology office equipment; production of new medical instruments and equipment for high-tech medical care; pharmaceutical production technology; production technologies of new materials with desired properties; aerospace technology; nuclear and renewable energy technologies.

The VI technological mode includes technologies in the following technological areas: nanotechnology; genetic engineering and cell technologies; artificial intelligence technology; additive technology.

Priority areas for innovative activity in the Republic of Belarus in perspective are the following (National Legal Internet Portal of the Republic of Belarus, 2017): energy and energy efficiency; agro-industrial technologies and production; industrial and construction technologies and production; medicine, pharmacy, medical equipment; chemical technologies, petrochemical; bio and nanotechnologies industry; information and communication and aerospace technologies; environmental management and deep processing of natural resources; national security and defense, emergency protection.

Table 4 presents a summary of long-term predictive indicators of innovative development of the Republic of Belarus. It is based on the study of program strategic documents.

Table 4. Evolving predictive indicators of innovative development of the Republic of Belarus, %

Indicator	2020	2025	2030
Share of innovatively active industrial organisations in the total number of organisations	26.0	27.5	30.0

Share of innovative products shipped in the total volume of products shipped by industrial organisations	21.5	23.0	25.0
Share of exports of high-tech products in the total volume of exports	33.0		
Share of extra budgetary sources in the domestic R&D costs	60.0	65.0	70.0
Domestic R&D costs,% of GDP	2.5	2.7	3.0
Share of high-tech activities in the industrial production	4-6	7-8	8-10

Source: research of the authors based on (Ministry of Economy of the Republic of Belarus, 2017a; National Legal Internet Portal of the Republic of Belarus, 2017).

Achievement of the planned indicators will provide transition of the Republic of Belarus to a qualitatively new stage of economic and innovative development. It will increase the competitiveness and investment attractiveness to ensure more effective use of available resource and intellectual potential, transform the structure of the economy of the Republic of Belarus by the transition to a high-tech production method.

7. PROPOSED NEW INNOVATION CO-ORDINATION MECHANISMS IN BELARUS AND CONCEPTS FOR EFFECTIVE CO-ORDINATION OF INNOVATION POLICY

From a government point of view an effective policy towards science and technology requires co-ordination mechanisms. On the one hand, there is the requirement for co-ordination between the ministries responsible for economy, regional economic development, education and science. In addition to the requirement of co-ordination of policy matters there is the need to co-ordinate policy execution.

As the authors emphasized in the introductory sections of this work, many countries are concentrating and focusing on the concept of designing a high level science and technology and innovation policy organizational function. This is recognized as a condition to develop and implement a holistic innovation strategy in which this institutional structure can coordinate new system. Projects and initiatives to modernize coordination and integration

Attempts have been found to work well in countries which we discussed such as Netherlands, Finland and Ireland

Overall the innovation management models **(Lundvall, 1992)** in the benchmark countries can be characterised as a continuous learning process of adapting organisations and practices to external and internal challenges. The snapshot view the study provided did not capture this nationally specific historical process in great depth.

Good practices cannot simply be transferred from one country to another. Nevertheless, the illustrations from the previous section on how the benchmark countries have tackled some of the key management issues, provide initial information to improve the efficiency and the effectiveness of the Belarus innovation management system.

As mentioned earlier on Section 7 on Strategic directions of innovative development one of the main goals of the State Program of Innovative Development of the Republic of Belarus for 2016-2020 is "Development and improvement of the NIS". Before presenting proposals the authors provide a summary analysis of the Belarusian NIS with the following priority issues:

(1) Regarding innovation policy issues in Belarus, the most important State bodies are the State Committee on Science and Technology of the Republic of Belarus, the NAS of Belarus, the Ministry of Education, the Ministry of Economy and the Ministry of Industry. Innovation policy is a horizontal policy by definition. The current level of collaboration between the three ministries can be improved in order to achieve an effective innovation policy. Therefore, it is necessary to derive a **stronger horizontal co-ordination mechanism.**

(2) Strengthen technology **transfer between public sector institutions and the private sector for both research and innovations**. Industry involvement ought to be generated in advance for long-term public sector research programmes. Financing is clearly seen as the main barrier to the provision of services to enterprises and more intensive science-industry co-operation.

(3) Restructure the fragmented public scientific and technological infrastructure. Regarding support infrastructure some shifts from basic vocational training and information diffusion to fostering the development of frontier technologies and specialized infrastructure are needed.

(4) There is room for **improvement in co-operation in the innovation support sub-system.**

(5) The focus of innovation policy should be shifted from horizontal support of business innovations to **targeted support of venture capital/private equity and specific technology areas.**

(6) Increase the amount of research in the private sector and perform and finance an increasing share of total R&D and innovations. There are two sides to this issue: increase the knowledge capability in view of industry's added value capacity as well as its potential to absorb knowledge from outside sources.

(7) Derive a strong co-ordination mechanism between national and regional innovation policy. In order to benefit from regional advantages, the differences between the regions show a need for a strengthened regional aspect of the NIS although the differences between the regions are not so relevant for Belarus.

Three alternative approaches towards an effective management system can be identified and will be described below, each of them with certain advantages and disadvantages. The main approaches are the following:

(1) Continuation of the present structure to achieve policy co-ordination;

(2) Appointment of one of the present ministries to perform the role of co-ordination;

(3) Co-ordination by a high-level Innovation Council.

Proposed, therefore, is a reengineered innovation system of the Republic of Belarus, which is represented by authors organisationally and diagrammatically as follows (Figure 3).

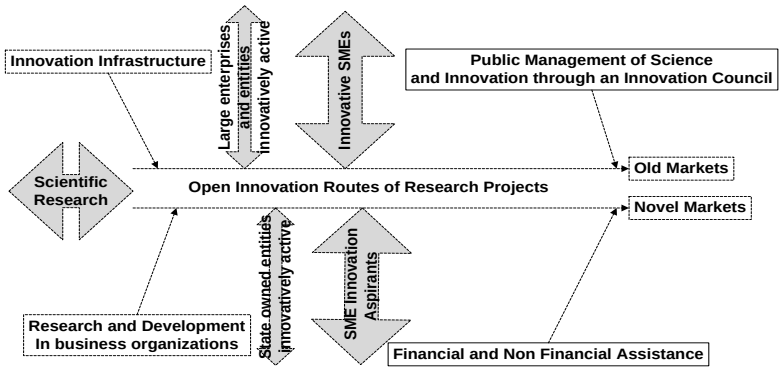

Figure 3. Evolving reengineered innovation system of the Republic of Belarus

Source: Illustration of the authors, integrating existing concepts in the "Strategiia Nauka i tekhnologii: 2018-2040" (2017, pp. 18-40) with new proposals

Source: Illustration of the authors, focusing on open innovation and reengineering the existing concepts in the Strategiia "Nauka i tekhnologii: 2018-2040" (2017, pp. 18-40)

Figure 3 suggests that external and internal innovations are integrated. In the concept, enterprises share the innovation road map, align their business model with those of stakeholders and incorporate the support of the policymakers, while focusing on new business opportunities as well as current business operations. Enterprise business models and approaches of the stakeholders are interconnected in an open model and, therefore, innovations become a significant criterion in their development. Furthermore, the management of innovations becomes the responsibility of every unit in an enterprise while intellectual property is treated as a "strategic asset". The mechanism of the reengineered innovation system and its impact on competitiveness of the Belarus economy is illustrated in Figure 4.

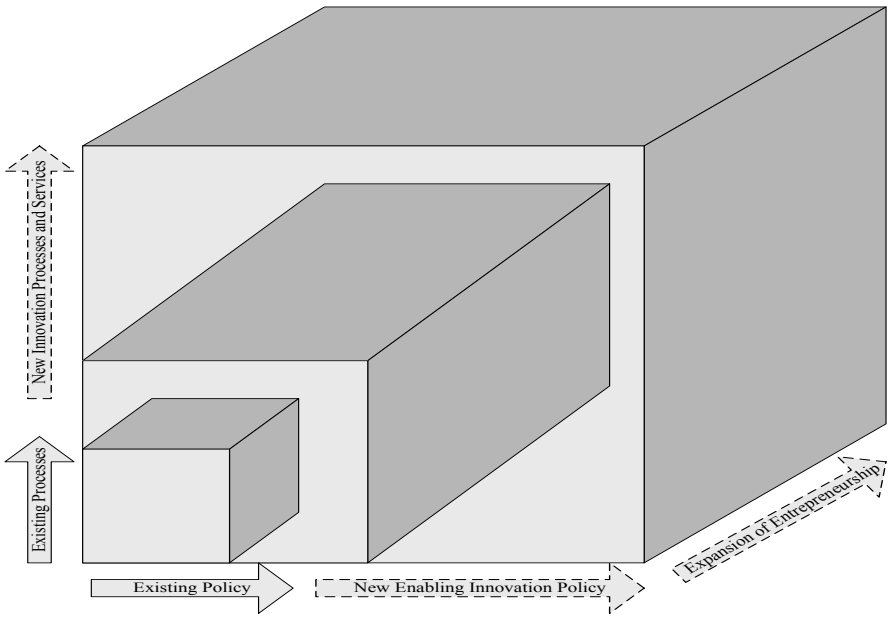

Figure 4. The mechanism of the reengineered innovation system of the Republic of Belarus existing

Source: Further illustration of the authors of concepts from Figure 4. and models from "Strategiia Nauka i tekhnologii: 2018-2040" (2017, pp. 18-40)

Authors are led to think that a proposed open innovation model will provide significant benefits for a wide variety of Belarus stakeholders, whereby the main benefits of the proposed approach are classified in Table 5.

Table 5. Summary of identified benefits of open innovative development for the Republic of Belarus

For Institutions providing Financial and Non-Financial Assistance; For Intermediaries	**For SMEs**
• Growth opportunity in leveraging the Research & Development &Innovation network • Benchmarks spreading across countries and main industry sectors • Availability of a full set of Innovation Management consulting tools • Competitive positioning as "leading intermediary" • Opportunity to leverage input on innovation best practices • Practical and effective means for evaluating SMEs'/high-tech start-ups' performance and risk	• Business interventions identified to fill the gap compared to best benchmarks • Benchmarking own Innovation Management performance with relevant tools • Benchmarking own performance in Innovation Management • Insight into best practice in Research & Development & Innovation Management
For Policy Actors and Public Administration of Science and Innovation	**For large enterprises and business entities or organisations/innovatively active**
• Understanding and management of existing threats and barriers to Innovation Management • Direct insight on key performance indicators for Innovation Management	• Benchmarks spreading across countries and main industry sectors Opportunity to cooperate with SMEs aspiring innovation • Competitive positioning in domestic and foreign markets by cooperating with other large enterprises and business entities or organisations/innovatively active • Opportunity to develop partnerships with state owned organizations and the private sector

Source: Own conclusions of the authors based on study of the current state and prospects of the development of innovative environment for doing business in the Republic of Belarus.

Responsibilities of the proposed Innovation Council should include (but not be limited to) awareness creation, agenda setting, co-ordination and the establishment of priorities. This Innovation Council should be chaired by the Prime minister and cabinet members in charge of the economy, science and education should be members. In addition, a number of chief executive officersfrom Belarusian innovatively active organisations should be members as well as a number of top scientists. A small number of members should be invited from other circles. A small select committee from the Belarus government should draft the Charter of the Innovation council including Membership and responsibilities.

8. CONCLUSION

The Belarus science and technology effort in support of innovation is still small and fragmented. An insufficient percentage of GDP is spent on it by the government, making Belarus one of the lowest spenders of public funds on this theme. In addition industry spending in R&D also is very minor. The number of public institutions performing R&D is very large. The relationship between science and private business is unsatisfactory.

What seems needed in Belarus is awareness that future wealth will depend a great deal on innovation activities and that organisational structures as well as government spending ought to be directed into that direction. Co-ordination of innovation measures among the Ministry of Economy and Regional Development, Ministry of Science and Technology and Ministry of Education and with other stakeholders needs to be a high priority in the medium term and steps to improve communication taken in the short term. The integration of business support and innovation activities needs to be co-ordinated. A more cohesive approach to entrepreneurship and innovation policy is needed to optimise the return on investment in both areas.

Our recommendation is that Belarus changes its innovation management structure to realise the transitions as required and we propose the establishment of a **high level Innovation Council. The National Science and Research Council (NSRC) could be envisaged by a Law on Innovation Activity** as a key designer of innovation policy in Belarus. Although relevant legislation exists since independence, there were no concrete implementation regading the official establishment of the Council. Future activities on co-ordination of

innovation policy measures should be directed in this way. A political will to procede with these activities is currently missing.

Responsibilities of the NSRC should include (but not be limited to) awareness creation, agenda setting, co-ordination and the establishment of priorities. The NSRC should be chaired by the Prime minister and cabinet members in charge of economy, science and education should be members. In addition a number of CEO's from innovative Belarus firms should be the members as well as a number of top-scientists. A small number of members should be invited from other circles. The functioning of the Innovation council would follow the parliamentary and political process.

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