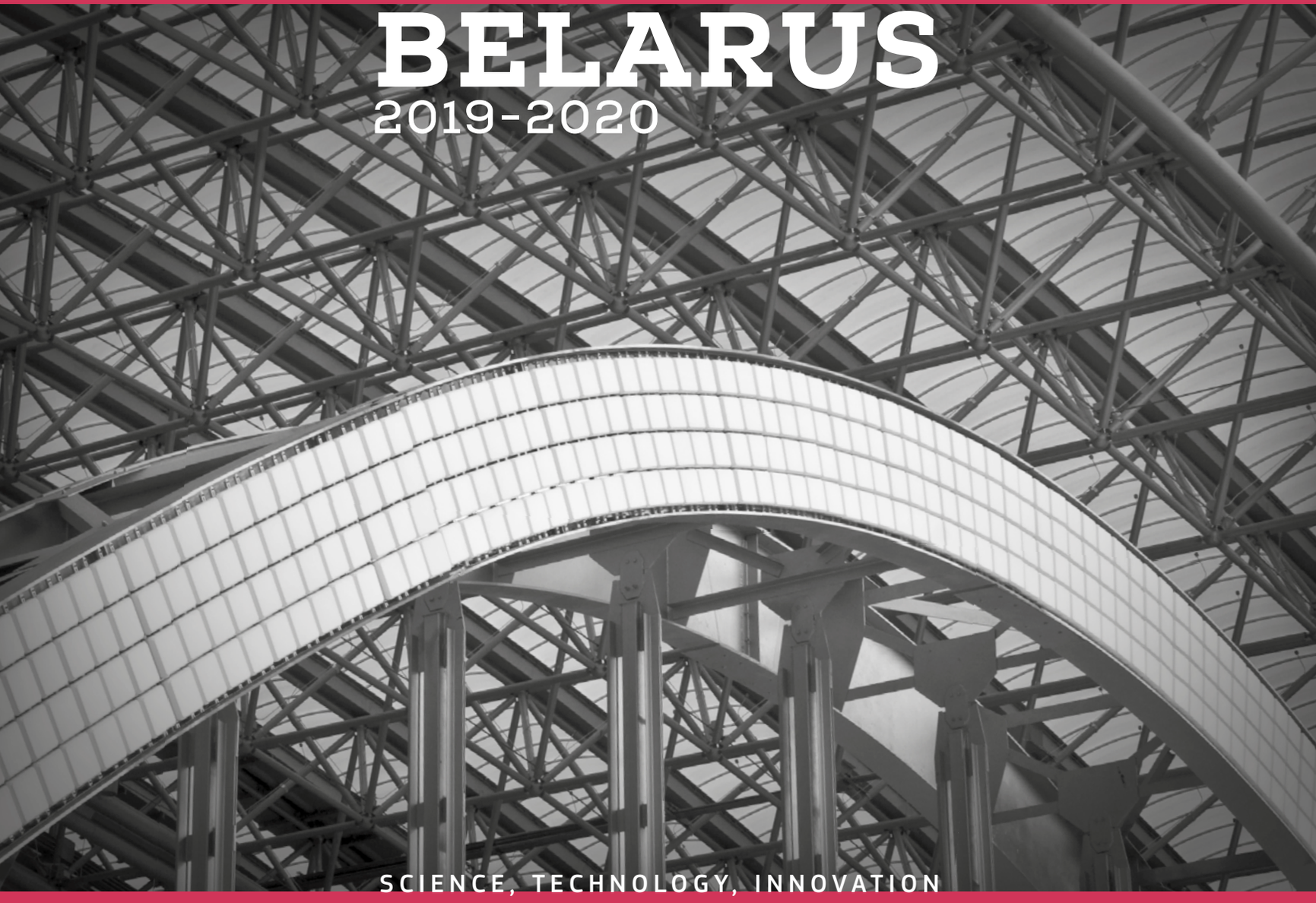
European Commission

TECHNOLOGY TRANSFER IN BELARUS 2019-2020



SCIENCE, TECHNOLOGY, INNOVATION

Joint Research Centre

TECHNOLOGY TRANSFER IN BELARUS 2019-2020

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Introduction

The present report contributes to the European Commission's commitment of bringing the EU and its neighbours closer. The EU's European Neighbourhood Policy was launched in 2004 to help the EU support and foster stability, security and prosperity in its closest neighbourhood, and it governs the EU's relations with 16 of its closest Eastern and Southern Neighbours.

The EU is committed to supporting the economic development of its partner countries. Technology transfer represents a central area where distinct sections of society including academia, private research, government and public and private enterprises interface with one another to improve the overall economic and social conditions for those involved and the communities around them. By investing in the facilitation of technology transfer, governments can direct policy and funds to ensure the greatest outcome for society. With this process in mind, the ultimate objective of the present study is to inform policymaking in technology transfer and build stronger cooperation between the EU and its Eastern and Southern neighbours.

Methodology

The Competence Centre on Technology Transfer of the Joint Research Centre launched this study to conduct a brief diagnostic analysis and comparative overview of the state of Technology Transfer in twelve Eastern and Southern neighbouring countries, including Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova, Ukraine, Algeria, Egypt, Jordan, Lebanon, Morocco and Tunisia.

The study describes the main characteristics of the landscape, including relevant stakeholders, players and technology transfer models, identifies strengths and weaknesses of the ecosystem, and provides conclusions and recommendations for each country, with the aim of informing policymaking in this domain.

To achieve this objective, the Expert Group commenced with a desktop review to gather, examine and understand relevant policies, laws and literature concerning technology transfer in the respective study countries. This preliminary phase was employed in order to characterise the status of the technology transfer in the region, to identify the key stakeholders, crucial issues and possible areas of improvement.

Secondly, the identified issues served as guiding material in the design of questionnaires for relevant stakeholders. The list of stakeholders included: Government bodies (Ministries with role in intellectual property and innovation, i.e. Ministry of Science, Education, Economy, etc., Innovation Agencies), Universities, Academies of Sciences (management, technology transfer offices, researchers), Industry (incubators, science and technology parks, companies), and private investors.

On-site interviews with stakeholders took place in some of the study countries before March 2020, however, in order to respect health and safety concerns of the Coronavirus disease (COVID-19), all interviews that took place after March 2020 were online via video conferences. Both the information from questionnaires and interviews helped as source data for the diagnostic country reports – an analysis of the technology transfer ecosystem and country specific recommendations.

Lastly, the study will conclude with a benchmark report to detail some of the similarities and differences between the countries to give relevant comparisons.

EXECUTIVE SUMMARY

Government

The economic model of Belarus is characterised by a strong public presence through central government interventions and ownership of enterprises. The growth in state-run industrial sectors backed by government wage and income policies in contrast with a limited small and medium enterprise (SME) presence indicates that the government policy has a larger influence on economic development than market mechanisms. The national innovation policy is an integral part of national socio-economic policy and is aimed at combining the resources of public (strong) and private (weak) sectors of the economy. The regulatory framework regarding the intellectual property rights (IPR) is relatively well developed but focused on the public sector. Foreign direct investment and entry of new enterprises remain heavily controlled (Dobrinsky, 2016) which deprives the economy of imports of new technologies as well as of the growth of SMEs. The negative effects of the recession of 2014-2016 have not yet passed, and the recent positive trends cannot be considered sustainable (Kazakevich & Haroshka, 2019).

Universities and Research organisations

Innovation activities within the public sector, including technology transfer (TT) from public research organisations (PROs), regulated and supported by the State Committee of Science and Technology (SCST), have been adopted by the National Academy of Sciences (NAS) and PROs. Most PROs have an internal intellectual property (IP) policy. Current legislation allows TT but restricts use of income from sale or licencing of innovations. Skills and focus of staff in technology transfer offices (TTOs) are asymmetrically weighted towards legal protection and TT into state-run industry. Most PROs have internal funds to maintain patents in the domestic system, however, a transfer of non-registered IP is preferred. The international patenting (Patent Cooperation Treaty (PCT), Eurasian) is rare. The quality of patented inventions is sufficient within the current development model of the country but is not competitive within global technological trends.

Industry

Innovation policy initiatives do not efficiently reach the private sector (spin-off and start-up companies, SMEs). The government has constrained competitiveness by high taxes and tariffs. SMEs are neither the leading supplier nor adopter of innovative technologies. Tax incentives are offered for technological start-ups placed in techno-parks, which works well, but the absence of available growth capital in the country restricts their progression to SMEs. The start-up founders overwhelmingly come from the private sector (Startups in Belarus, 2018).

Support organisations

The support system for TT from PROs to state-run enterprises is fairly well developed, and there are unified open national technology registries that link PROs to industrial partners. State-run techno-parks affiliated with the largest universities and focused on providing support for achieving 'manufacturing readiness' for early-stage technologies originating from PROs, exist. The country has an established Business Angel Network (BAN) and there is early evidence of the venture capital industry developing with Russian partners.

Technology transfer

The government plays a significant role in the regulation of all aspects of the economy in Belarus. The innovation process is heavily regulated and highly centralised. Large national companies are the main technology adopters in the country. TT resources at PROs are available. TTOs are skilled in transfer to state-run industry but have limited knowledge in market research and technology appraisal for commercial potential. There is little interaction between the public and the private sector. The system of innovation funding is centralised and complicated with a low variety of financial instruments available to bolster innovation. Funding programmes support technology development to manufacturing but penalties exist for not succeeding. Lack of information on opportunities for cooperation in the private sector and internationally, high costs faced by organisations in the case of failure of technology valorisation, lack of availability of private capital and TT infrastructure strongly pivoted towards the public sector have been identified as hindering TT and collaboration opportunities.

General findings

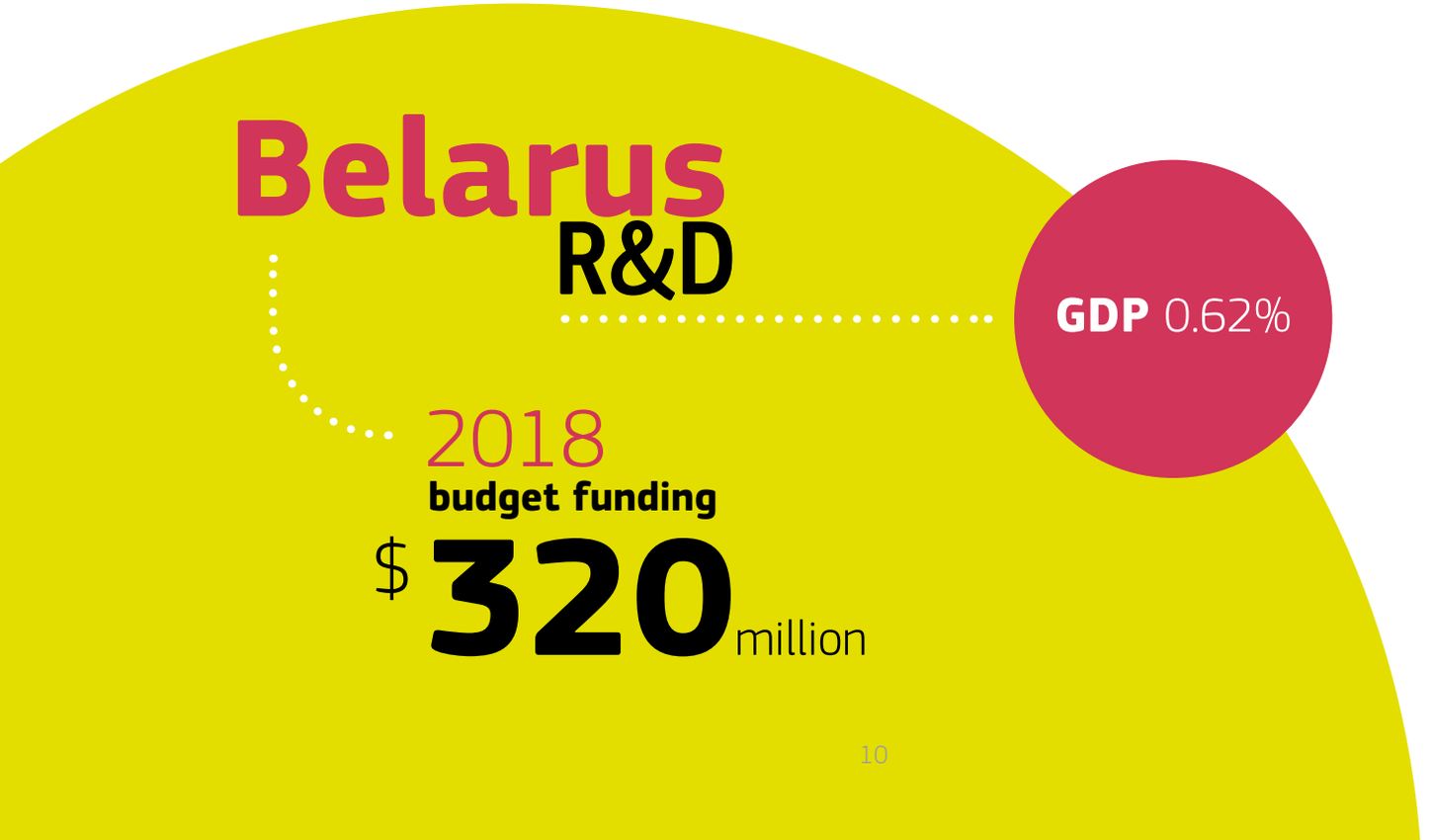
Government

National economic strategy

In 2018, the amount of budget funding provided for research & development (R&D) activities remained low at 0.62% of gross domestic product (GDP) which equals ~USD 320 million (Kazakevich & Haroshka, 2019).

In comparison, in 2008 the R&D spending in Belarus was USD 450 million; the total losses for the sector in 2018 were ~USD 740 million. The recession of 2014-2016 resulted in some growth in external funding for R&D from 10% in 2008 to 16% in 2017. According to the Decree of the President of Belarus of 31 January 2017 "On the state programme of innovative development of the Republic of Belarus for the period 2016-2020", an 'innovative way' of development of the economy is determined as one of the priorities of the national socio-economic growth. The governance of innovation, and by extension, TT activities, is centralised and strongly focused on domestic technology implementation. Within PROs, the conversion factor from basic to applied research is one in three and from applied research to commercial product is one in eight.

Innovation policy in the country is the remit of the SCST supported by a multi-ministerial and industrial council (Decree of the President of the Republic of Belarus, 2017). The council includes the following types of public entities: Central government (Ministries of Architecture and Construction, Utilities, Health, Education, Natural Resources and Environment, Industry, Agriculture, Sport and Tourism, Transport and Communications, Energy); National Committees of Military Industry, Property, Standards; National Concern of Food Industries, Oil and Chemical Enterprises, Wood and Paper; NAS; National Union of Consumers; Local government (Regional Executive Committees and Minsk City Executive Committee); Belarusian Innovation Fund (BIF). The policy implementation is guided centrally by the SCST which includes an IT (information technology) institute, the Republican Library for Science and Technology, the National IP centre, BIF, two regional Technical and Business Information Centres and a Centre for Analytics in Innovation and TT. Policy implementation is controlled by the National Committee of State Control and the Council of Ministers. The implementation of the national innovation policy is carried out on the 'project-based' principle. Drafts of the policy will be included in the State Programme of innovative development of the Republic of Belarus for the period 2021-2025.



The strategy of the innovative development, provided for by the State Programme, is focused on the implementation of technologies related to V and VI technological paradigms[1] into traditional sectors of the economy. Importantly, in some sectors the strategy relies on homegrown technologies and in some – on "catch-up" strategy with the active translation of advanced foreign technologies (Council of Ministers of the Republic of Belarus, 2012).

The implementation of the provisions of the state strategy will be carried out in cooperation with the World Intellectual Property Organization (WIPO) and leading PROs and guided by the SCST.

The strategy is aimed at increasing the control of the state over the IP and innovation management process. The normative regulation for compulsory licences for technologies of high priority within health care, energy conservation and other socially important sectors have been introduced. It requires monitoring the research created by using the budget funds at the institutional level to track budget revenues as well as budget expenses associated with the creation and use of IP. The centrally managed system permits the alignment of the national strategy, at least at the administrative level, with the institutional strategies of Belarusian higher education institutions (HEIs) and in the NAS and its subordinate PROs quickly and effectively. However, the implementation of the strategy in PROs will be challenging due to the low availability of funds and the significant investment required to improve the performance of the R&D sector in the country. This will be further exacerbated by the need to update the ageing infrastructure and equipment, particularly in medicine, gene engineering, and nanotechnology areas. To stimulate the involvement of the private sector in innovation activity, the government stipulates the creation of public-private partnerships, where the risks and benefits of innovation are shared. In 2017, the guidelines included the possibility of transferring the IP developed with the use of budget funds to a private partner. This kind of collaboration, however, is still rare in practice due to the comparative lack of SMEs and large privately-held industrial companies in the country.

National regulatory framework of IP

The statutory legal acts on the assessment of IPRs, their registration as intangible assets for accounting purposes, protection and commercialisation have been mostly adopted between 1993 and 2003 and are supported by more recent Decrees of the President of the Republic of Belarus and policy laws. Specific laws that relate to TT from PROs to industry have been subjected to many amendments and major changes between 2010 and 2017. Belarusian legislation accepts the priority of conventional principles of international law in IPR protection. The Civil Code and the Civil Procedure Code provide for methods of protection of exclusive rights and measures for the security of claims related to IPR infringement. The Customs Code provides for procedures related to border measures. The Criminal Code and the Code on Administrative Violations provide for criminal and administrative penalties to be applied in cases of IPR infringement. Ownership was originally regulated by the Civil Code but more recently this has been changed to specific IP and commercialisation laws. The entire regulation and legal framework that supports and regulates research commercialisation activity in the country contains about 100 main normative legal acts covering international framework agreements on the innovation activity and the cooperation in the R&D area, stimulation measures for creating and commercialising research results for legal entities and individuals, regulation of TT into the marketplace and to state-owned industry, IPR valuation, management of intangible assets, including transfer, sale, loan, shared ownership, and export by the state, and the use of military and dual technologies.

BELARUS HAS A WELL-DEVELOPED NORMATIVE IP FRAMEWORK, WHICH FOLLOWS THE LATEST GLOBAL DEVELOPMENTS IN REGULATING IPRS.

The framework permits protection of copyright (including software, databases, and related rights), technical inventions, utility models, industrial designs, non-disclosed information (including trade secrets and know-how), trademarks (trade symbols and service marks[2]), topographies of integrated circuits, plant varieties, and provides protection against unfair competition. The SCST is a state administration authority responsible for carrying out government policy in IPR protection. The SCST has three subordinate organisations which are responsible for particular functions regarding IPR management. The National Centre of IP (NCIP) is directly responsible for the legal protection of IPR and performs the functions of a state patent office covering patent drafting, filing and prosecution, developing and implementing national IPR policy and IP valuation guidelines, drafting IPR laws and amendments, IPR management

1 V technological paradigm includes ICT technologies, robotics, telecoms, oil & gas, biotechnology, space technology (satellites), functional materials, and high-tech medicine. VI technological paradigm includes nanomaterials and nanotechnologies, gene engineering, H-based and thermonuclear energy solutions, AI (artificial intelligence) and global information technologies.

2 Service mark is a term that was used in the Soviet Union and means a type of a trademark.

for copyright owners, liaison with WIPO, and registering patent attorneys. The Chamber for IP Disputes of the Supreme Court is a specialised panel of judges which hears and rules dispute litigations arising from the creation of IPR, legal protection and use. The Republican Library for Science and Technologies performs the functions of managing a publicly accessible national patent repository. In addition, to prevent the abuse of IPR, the State Commission on IPR Protection and IP Violation Control were set up. The commission considers countermeasures against IPR violations, governmental incentives to facilitate processes of legally protecting IP and effecting IP commercialisation, and international cooperation.

Procedures related to patenting and copyright law in Belarus are harmonised with international systems administered by WIPO including the Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement, the Nice Classification, the Strasbourg Agreement, the Locarno Agreement, the Madrid Agreement, the Budapest Agreement and the Singapore Agreement. Belarus also participates in a number of IP agreements concluded within the framework of the Commonwealth of Independent States (CIS) including mutual protection of IPR (focused on industrially important design patents) with the Russian Federation, Ukraine, Armenia, Poland, Czech Republic, Moldova, Azerbaijan, Kyrgyzstan and an additional agreement on mutual protection of IPR on military and dual-use technologies with Ukraine. The government has harmonised regulation of utility models and are in the process of joining the Marrakesh Treaty which is a part of the current revision of the copyright laws aimed to provide adequate protection to software and OTT[3] technologies. The NCIP is currently liaising with WIPO on drafting a new Copyright Act, expected to enter into force in May 2020.

Documented evidence for the effectiveness of the IPR enforcement regime nationally is available to the public. Appeals are regulated by the detailed NCIP protocol and the statistics are collected. The number of engagements with courts (IPR suits and appeals) is low. The 2017-2018 data shows that the majority of cases (~90%) are related to trademark use and registration. Trademarks are the least common IPR asset in TT agreements nationally and the high number of disputes indicates the weak legislation in this area.

3 OTT (over-the-top) technologies refer to film and television content provided via a high-speed Internet connection and encompass services such as Netflix, Amazon, iTunes and HBO Now offer.

Ownership and minimum royalties for technologies funded by the state are regulated by law. Belarus has an institutional, automatic ownership system for such assets specifying the PRO/NAS as the owner of the IPR. There are no reversion rights to the employee-inventor and no monetary incentives for researchers outside of 'administrative incentive' meaning the administration can increase the salaries of employees in PROs by 200-300% using various surcharges and premiums. However, the monetary incentives remain at the discretion of the management and though the current system strengthens the administrative principles of a PRO, it does not explicitly encourage participation in TT. The law allows for co-ownership of public and private entities, sale or transfer of the IPR resulting from state-funded research to private companies or international organisations, and negotiations with private companies regarding royalties are permitted. However, the laws are unclear on the distribution of royalties resulting from the commercialisation of fully or partially state-funded research which results in limited TT from the public to the private sector and international commercialisation. Another limitation is the legal requirement that the inventions must be commercialised nationally before they are transferred abroad. Though similar to the Horizon 2020 approach that recommends commercialisation in the EU first, in Belarus this requirement is restrictive as it is limited to a much smaller and narrower market and hinders the development of technologies in PROs in sectors which are not yet sufficiently strong in the domestic market but might be highly innovative and/or in high demand abroad.

Overall, the analysis of all the aspects of the regulatory and legal framework of the Republic of Belarus shows an imbalance between the IPR/TT related laws, complying with international standards, and the efficiency of their practical application. This seems to result from the lack of expertise in IP and innovation management in general, and the lack of qualified specialists in government institutions/enterprises rather than law provision or the completeness of regulatory framework.

Availability of investment capital

National innovation policy regulates the investment from public sources. The government has allocated provision through the state and the local budgets to carry out the implementation of innovation policy. Extra-budgetary funds are also available, e.g. allocation of funds held by state-owned enterprises and private-public partnerships[4]. A new centralised innovation fund, BIF, is being formed to finance innovation projects of national importance with BYN 743.6 billion allocated for innovation projects and development of innovation infrastructure. Financial instruments used to stimulate innovation and R&D activities are limited to tax incentives (Shuleiko, 2016) e.g. VAT (value-added tax) exemption for commercial activities involving technology development, income from commercial exploitation of IPR, import of scientific equipment; income tax exemption for some techno-parks; property tax exemptions for techno-parks and PROs.

However, the complicated procedures needed to obtain the reduced tax rates, requiring the confirmation of the 'innovativeness' of the activity by the SCST, plus the narrow spectrum of limited lifespan reliefs offered to SMEs hinders the effectiveness of these methods in stimulating innovation activity. The recent analysis (Veko, 2018) showed that during the period 2011-2016, the number of organisations involved in innovation activity reduced from 91 to 79, the share of innovative products dropped from 23.4% to 15%, and the number of active researchers and R&D centres – from 22 600 to 18 600 and from 329 to 264 respectively. Revenues received from the commercialisation of innovative products and services reduced from BYN 2.2 billion to BYN 1.6 billion despite the increase in innovation spending by BYN 16.4 billion. In the same period, the share of local budgetary funds spent on technological innovation increased from 0.2% to 16.2%, however, a corresponding increase in innovative products and services or improvement in innovation infrastructure has not been observed.

4 In Belarus, the current examples of existing private-public partnerships are state infrastructure construction projects e.g. construction of Beshenkovichy hydropower station at Western Dvina in Vitebsk region overseen by the Ministry of Energy.

FINANCE

A new centralised innovation fund of BYN 743.6 billion will finance innovation projects of national importance

Universities and research organisations

NAS who has overall authority for applied research, innovation, and technology transfer, plays an important role in innovation policy coordination and implementation. NAS was specifically redesigned as a national centre of applied science and TT aiming to conduct, support and implement the results of scientific R&D, and includes 111 organisations among which there are 72 innovation centres dedicated to connecting PROs to industrial technology adopters. The procedures for project evaluation are relatively clear with the performance and the perceived economic impact of the invention as the key assessment. NAS has participated in the distribution of budgetary funding for all PROs, however, this function has been recently revoked. NAS is actively participating in all stages of the innovation process and funding programmes and the majority of patents filed in Belarus originate from this organisation. Traditionally NAS has a stronger focus on the earlier stages of technology development.

State funding for research is divided into fundamental and applied. The applied research programmes support three stages of technology development: early (to technology readiness level (TRL) 2), prototype and testing, and the 'manufacturing readiness' phase. The 'manufacturing readiness' phase often takes place in the PROs who have their own small scale sample manufacturing facilities. These facilities are commercially run and generate revenue, but the overall aim remains to transfer the technology to a larger industrial partner serving mass markets. This system was developed to assure TT to large state-owned companies, is established, culturally accepted and was functioning well until the last decade.

Considerable effort has been put by the NAS recently into creating an online national registry of innovative solutions developed within PROs (National Academy of Sciences, 2019) to provide access to available technologies for both national and international adopters. The registry portal is managed by NAS's Republican Centre for TT and provides easy access to the up-to-date technologies' lists. However, the grasp of the requirements of the national industry and its capability to absorb new technologies remain variable within PROs. Similar challenges were observed within the area of international commercialisation and export of technological solutions.

Intellectual Property

The lack of unified documented policy of IP management and technology transfer is an acknowledged problem in PROs. A new unified national policy on IP is expected to be drafted in 2020. The institutional policy for the NAS's institutes - beneficiaries of the unified policy, is expected to be developed in 2021.

The IP units (currently 36) within the PROs are rarely supported by internal resources beyond the drafting of a patent application. As the legal fees associated with patenting nationally are waived/ significantly reduced for PROs by law, PROs tend to work with the NCIP's support personnel directly. International patenting (e.g. filing with the United States Patent and Trademark Office (USPTO), Eurasian Patent Office (EAPO) or using the WIPO administered PCT route) is rarely subsidised by a PRO due to low available funds, which results in low numbers of European and international patents and trademarks granted (14 total granted between 1994 and 2018). The number of national patents is also declining as experienced inventors recognise that filing nationally increases the risk of providing an enabling disclosure to the international community without any benefit to them or their PRO. To circumnavigate this, the overwhelming majority of inventions offered within national registries are in the form of non-disclosed IP. The patent filing metrics are included in the organisational rankings for PROs and increase their likelihood of a higher R&D allocation but seem to have little influence on individual career progression of the researchers beyond PhD candidate level.

INCREASED ALIGNMENT OF THE OUTPUTS OF PUBLIC R&D ACTIVITY WITH IP PROTECTION ACTIVITY HAS BEEN ACHIEVED SOMEWHAT THROUGH THE INTRODUCTION OF OBLIGATORY FILING OF A PATENT APPLICATION AS A PART OF PHD THESIS DEFENCE PROCEDURE.

However, the negative viewpoint on national patenting and patenting requirements levied at less experienced researchers, contribute to the insufficient competitiveness of Belarusian patents.

The IPR ownership within PROs is imitated by law to the PRO/NAS ownership for the inventions funded from the state budget. In such cases, the researcher receives 40% of the profits. In the R&D sector, the applied research is 80% state-funded and the strong state intervention can present some difficulties in implementation (see Government section for more details) of this policy. Co-ownership of inventions funded from both private and public sources is possible and here the share of royalties is negotiable.

Technology transfer offices

The TTOs are skilled in TT to domestic industry and organise regular bi-monthly meetings with the industrial sector where a 'bank of industry demands' collected in advance is reviewed. The TTOs act as technology brokers and fully manage the relationship with the industrial partner. This approach was initiated several years ago and is proving successful in obtaining contract research agreements for PROs. The contract research is usually funded by one of the state innovation programmes, which encourage PRO-industry collaborations. Same approach might be successfully applied to international commercialisation, however, the regulations on benefits obtained from such TT abroad is not clear (see Government section for more details).

TTOs, 29 in total, are united under the Republican Centre for TT (RCTT), founded in 2003 under the auspices of the SCST, the NAS, the United Nations Development Programme (UNDP) and the United Nations Industrial Development Organization (UNIDO). RCTT is part of international networks and its primary goal is to promote the cooperation between developers/adopters of technologies and potential investors. RCTT is actively engaged in technology marketing, provides access to national technology registries, UNIDO network and other international databases, acting as the national and international technology broker, provides courses in innovation-oriented entrepreneurship, IP management webinars, etc. RCTT is well-positioned and fairly well equipped for improving the TT skills in the country, however, it lacks the technology foresight required to align the national technological capabilities with global trends.

Available technology transfer skills and human resources

The strong focus on TT from PROs into national industry allowed Belarus to preserve its traditional industrial sectors and R&D/education system, but left the country generally lacking in skills within most other aspects of TT and technology translation. The government recognises the lack of experience and functional capabilities to commercialise innovation as the national problem in Belarus. In particular, the main weakness has been identified as the lack of knowledge, skills and organisational structure nationwide required to effectively scout new home-grown and foreign technologies that can be deployed to renovate the traditional industry sectors and increase domestic production.

Basic training on IP and innovation management is provided by the NCIP. The journal "IP in Belarus" provides the information and methodological support on the IP framework. Between 2006 and 2014, all HEIs provided a course on "Fundamentals of IP Management" and IP management was integrated into a number of educational programmes. However, since 2014, due to the lack of funding, this course has been downgraded to facultative and is no longer included in the obligatory undergraduate programmes in many HEIs. The NCIP, the NAS and the PROs deliver IP training to help raise awareness within the academic community and the distance learning with WIPO is available. The overall strategy at present is focused on raising the number of patent applications, education and improving the understanding of IPR enforcement. Staff at TTOs and associated units are traditionally weighted towards legal protection, accounting and economic benefit evaluation of technologies. Skills in commercial evaluation, commercialisation strategy, market research and negotiations with private sector are limited.

Contract research/ Collaboration with industry

Undertaking contract research for industry is a tradition for the NAS and PROs; the tendency to focus on applied science and the government regulations ensure demand. The level of demand from the state-owned industry is reflected in TTOs mostly being engaged in industrial contract research activity. The demand from the private sector is low but where it exists, the most prevalent form of engagement with a PRO is also contract research, followed by technology licencing, franchise contracts, consultancy services and ceding the IPR to an industrial partner. Most PROs and universities actively participate in international R&D programmes attracting foreign research grants. For example, Belarusian partners took part in 41 Horizon 2020 projects as of February 2019. Though this activity attracts significant amounts of foreign currency to the republic annually, the results usually do not find commercial use in Belarus.

Licencing activity was effectively stimulated in 2012 by waiving of all taxation on income from licencing (formerly at 40%).

The most popular formats of TT transitioned from ceding the IPR to the formal licencing contacts, and the latter is now the dominant format with 354 licencing agreements registered nationally in 2018. Structurally, the licencing agreements are divided as know-how/trade secret (50%), technology patent (30%), utility models (12%), plant variety patent (6%) and trademark use agreement (2%). The percentages are provided for 2017, as this was the last year know-how/trade secret transfer agreements were structured as a licence and the data on such agreements was collected. Since 2018, the new law removed the exclusivity right from know-how/trade secret transfer agreements so the data on such agreements is no longer collected. Statistics on copyright agreements e.g. for the sale of software and databases are not currently gathered.

The majority of licencing agreements are in the public sector with leading adopters being Ministry of Education, Ministry of Health, Ministry of Transport, Ministry of Production, and Ministry of Agriculture and the leading providers being the NAS and PROs. An analysis of licencing deals showed that foreign organisations are participating more in contract research, while domestic companies are involved in contract research, licencing of technologies, trademarks, plant varieties, and know-how. The foreign organisation-licensors originated mainly from the Russian Federation, USA, and Canada in the last few years. Detailed analysis carried out in 2017-2019 (Nechepurenko, 2017; 2019) allows to conclude that the PROs are the major sources of creation of new technologies, utility models, know-how and other forms of IP and very efficient in TT to state-owned industry enterprises. However, the majority have a weak entrepreneurial culture.

The Centre for Analytics in Innovation and TT of the SCST has direct responsibility for TT activities. The centre offers general consulting services and connects PROs to SMEs/sole traders. However, the interaction between the business and research sectors is weak. Lack of SMEs and privately-owned industrial companies, high costs faced by organisations in the situations where the technology commercialisation fails, lack of commercial orientation among PROs and HEIs have all been identified as hindering collaboration opportunities. Belarusian's state policies aim at closing this gap through private sector incentivisation and establishment of techno-parks, but this has been inefficient to date.

Finally, the Republican TT Centre, linked to a Belarusian business-innovation centre of the European TT Support Network, acts as a technology broker for PROs in the international space. The centre has an office in Zhejiang Province, China and is active globally. However, the survey of foreign technology requests, currently available, shows that out of 209 requests from foreign entities listed (Republican Centre for the Technology Transfer, 2019), only five are recent (submitted in 2018) and these are all requests for a manufacturing partner. Within the last five years, 15 technology requests from international organisations were posted, out of which only four are seeking TT in a form of a licencing deal or a joint venture (JV) formation; the others are related to contract R&D services, distribution and manufacturing contracts and material recycling requests; this shows the slow acceptance of Belarus as a global technology hub outside of SaaS (Software-as-a-Service) space (see Start-ups subsection for more details on the SaaS sector).

Faculty and researchers/ Quality of scientific research

The average age of researchers in Belarus is increasing as more graduates are choosing to seek employment in the private sector where remuneration and opportunities for career advancement are higher. HEIs, the NAS and PROs are strongly focused on applied research and lecturing staff usually undertake research as well. Entrepreneurial skills are not usually taught although several HEIs now have start-up incubators on site. HEIs are allowed to establish start-ups to transfer technologies to the market e.g. the Belarusian State University (BSU), the strongest in the country, has nine unitary enterprises as separate legal entities, each with its own production facilities, and fund-collecting revenue from companies in BSU techno-park. Similar commercial enterprises focused on self-funding (United Nation Economic Commission for Europe, 2017) exist within the NAS.

Traditionally, Belarus has had a strong scientific base both in terms of workforce and infrastructure. The scientific areas that have been identified in fieldwork interviews as particularly strong are IT, chemical industry, materials, mechanical engineering. However, the scientific potential has been eroded by the unfavourable economic conditions in the country, especially during the deep recession of 2014-2016, which resulted in significant losses in the R&D workforce. This impacts on the overall number and the quality of inventions.

THE 'BRAIN DRAIN' FROM BELARUS TO GERMANY, THE US AND THE RUSSIAN FEDERATION IS NOTABLE AS WELL AS THE VISIBILITY OF BELARUSIAN INVENTORS ON US PATENTS FILED BY US COMPANIES AND EU PATENTS FILED BY EU COMPANIES.

While there are no metrics that suggest a decline in quality of basic science in HEIs and PROs, the recent analysis of technical solutions, filed for domestic patents, by the Belorussian authorities shows that they do not provide a sufficient basis for the development of competitive technological trends (Decree of the President of the Republic of Belarus, 2017).

The declining competitiveness of the scientific research outputs has been recognised by the government as a problem that requires an urgent solution. However, the majority of corrective efforts are focused on the improvement of the availability of information on the global technological trends, industry forecasts, market research by sector and open source solutions, and on increasing involvement of researchers in collaborations with foreign partners. While this will improve significantly the organisational structures for TT and knowledge exchange in the short-term, the gain of competitive strength in new technological sectors will be slow until the problem of low investment in R&D sector (both workforce and infrastructure) is addressed.

Industry

Technology transfer from PROs

All state programmes responsible for funding applied science are expected to result in an invention ready for production. Three years after the date of acceptance of the invention for commercialisation by an industrial partner or after the grant of the patent document, the research output is expected to be in the commercial manufacturing phase. This commercialisation period is expected to be met but can be extended by 3-5 years at the discretion of the SCST. If the commercialisation has failed, the grant must be repaid to the government in full. If the commercialisation was partially achieved, only the part of the grant that was not fulfilled must be returned (Nechepurenko, 2019a). The responsibility for repayment rests with the PROs and the industrial partner. This structure was developed to reduce the risk of technology failure and increase the return on investment (ROI) from public R&D financing. However, when implemented, it curtailed interest in participation, reduced the level of invention and reinforced the role of large state-owned companies in TT, as the risk that the R&D grant will have to be re-paid is considerably easier to leverage within a large established industrial entity with diversified revenues. State-owned companies use this form of funding as well as partnering with a PRO directly to transfer a de-risked technology in the industrial environment.

Intellectual Property

State-owned industrial enterprises normally pre-assign all rights to the PRO on the understanding that the invention will be commercialised through them in the next three years. Companies, both public and private, can typically use the invention royalty-free for the first 2-3 years and then royalties are expected to be paid to the university. The assessment of invention value (as IP) is determined by an independent evaluator, accredited by the state and cannot be disputed.

Spin-offs/ Start-ups

Graduate start-ups and spin-offs from universities/PROs are very few. Belarus still lacks incubator and accelerator programmes aimed at non-software businesses. This TT route is under-represented and only state-run techno-parks are available for high tech start-ups. At the science & technology (S&T) Park "Polytecknic" of the Belarusian National Technical University (BNTU) a Start-up School is being formed to close this gap. 'Service' R&D companies established to offer commercial services of a PRO that might be regarded as spin-offs have long existed in Belarus. Such companies do not break free of the parent and tend to be size and capacity limited. There is no legislation that prevents a researcher starting their own company and the conditions e.g. at the techno-parks, are quite good for completing the last mile effort: expertise, equipment and industry relationships are present but little-to-none collaborative industry research. However, according to the available statistics, despite the seemingly favourable conditions for growing companies in techno-parks only 6.5% of start-up founders were students, only 4.2% were graduate-level researchers, and only 1.2% were postdoc level researchers when they founded the company; the majority come from the private sector.

THE MAJORITY OF ACTIVE START-UPS HAVE BEEN FORMED INDEPENDENTLY OF PROs AND ARE IN THE ICT (INFORMATION AND COMMUNICATIONS TECHNOLOGY) SECTOR.

Often these businesses act as private 'service' companies to foreign software development companies and rarely have their own product offering. There are no government statistics on start-ups and a 'start-up' form of company is not recognised within the normative framework. In 2018, a business club "Imaguru' collected data on ~1,000 start-up companies in Belarus (full coverage of active companies at the time) and AID-Venture with support of United States Agency for International Development (USAID) interviewed 214 (21.4%) of these start-ups and provided an overview of the start-up space (Startups in Belarus, 2018). The majority of start-ups have been formed less than three years ago (88.9%), with about a half having been formed less than a year ago, are registered in Belarus and concentrated in Minsk. Start-ups that have not yet participated in a fundraising round (c~40%) are not registered as legal entities and in 13% of cases, their founders are sole traders. Approximately half of all start-ups have a working prototype. A third of start-ups have some sales, though their revenues are low (USD 5 000 were reported). The prevalent business model is B2B (Business-to-business) (72,4%) aimed at private companies and corporations, which is quite similar to the prevalent business model in Poland (76%). Founders are usually well educated, 87.8% hold a bachelor's degree and 25% hold a graduate degree or higher. Over 60% of founders speak adequately to excellent English as this is considered a vital skill for successful fundraising and rolling-out the product onto the

international market. Over half of all companies are targeting the domestic market, 37% are aiming at the global market and the rest are planning to sell to the Russian Federation and Europe. The main areas of application within the ICT sector are SaaS, AI, fintech, and gaming, with about 10% of companies working in blockchain. These sectors are characterised by low initial investment levels, and high engineer value (up to USD 1 million per experienced employee) in Central and Western Europe, and in the US. More advanced ICT applications e.g. Big Data in Healthcare, analytics, digital twins, Internet of Things (IoT) which have similar characteristics but additionally require well developed digital infrastructure and sophisticated industry, are not present.

There are several success stories. FriendlyData has been accepted into the 500 Startups accelerator, BotCube – into Boost VC in the Silicon Valley, IQBoxy – into Y Combinator. WorkFusion, an American-Belarusian JV, PandaDoc, and Banuba raised USD 35 million, USD 15 million, and USD 5 million respectively from international VCs (venture capital). AI MATTER was bought by Google in 2017, the first international trade exit for a Belarusian company. However, as the financial infrastructure is still under development only a few start-ups have access to capital. There is no TT from the HEIs and PROs to private industry via start-ups; technologies, requiring well-developed infrastructure, access to expensive equipment and research facilities, long development cycles are not present among the sectors with high start-up activity. The main barriers to effective financing of early-stage companies, identified by the AID-Venture survey, were the low number of active investors, low trust in the legal system by investors and start-up management, small market size, and the preferred way of the founders to overcome these difficulties via immigration. Russian Federation, Lithuania, Estonia, Israel, Cyprus and Singapore are the most popular destinations due to ease of company registration, better courts, a support system for start-ups (incubators and accelerators with training programmes), access to wider markets and higher involvement of universities with start-up companies e.g. through collaborative research or technology/know-how licencing.

Support organisations

There is evidence of professional support to the IPR system. As of 2019, there are 66 registered patent attorneys in the private and public sector including two dedicated commercial companies working in industrial IP management and several IP units at PROs. There are 118 IP evaluators (accountants) and commercial agencies specialising in the preparation and negotiation of licences. There are also organisations of collective IPR management e.g. the BOIR (Belarusian Society of Inventors and Innovators), a public association providing organisational assistance, legally enforceable documents and methodological support, the Belarusian Authors' Society involved in management of copyright and related rights, and others. The state-run support infrastructure includes nine Centres of TT, registered with the SCST; RCTT, a voluntary organisation of state governing bodies, commercial and non-commercial organisations with five regional centres and 29 TTOs positioned in PROs and HEIs; 16 state-run techno-parks, registered with the SCST (not considered free economic zones (Kolkin, 2018)); the Great Stone Industrial Park (GSIP), Belarusian-Chinese joint industrial park in the Minsk region which is expected to have 70 resident companies by 2020.

The prevailing approach at state-run techno-parks is to allow the technology developer to use the facilities to scale up/refine the production process but is not aimed at creating an independent commercial entity operating in the free market. There are national (direct and indirect) funding programmes to support techno-parks. The technologies entering the techno-parks originate mostly from PROs, and the technologies exiting are typically directly absorbed into state enterprises or became service companies to the state-owned player. The business incubators and technology accelerators are not available, with the first privately-run techno-parks being established to fill this gap. The legislation makes it possible for PROs to establish wholly-owned incubators, but it is unclear whether PROs would be able to operate an accelerator model of holding equity stakes in start-ups or secure project-based funding without state intervention in the selection process.

The financing requirement for start-ups in Belarus is USD 85 million and is projected to exceed USD 100 million/annum in the near term. Currently, the majority of investment (55%) is coming from the global VC community. The availability of private capital domestically is still limited and securing sufficient funds for product roll-out is still a problem for the majority of start-ups. 83.5% of start-ups are bootstrapping and using their own funds. However, the VC activity in Belarus is growing e.g. "Zubr Capital" that invested in ActivePlatform, ActiveCloud, and the largest Belarusian e-commerce company 21vek.by (average size of investment USD 3-7 million) was ranked by PitchBook.com as the most active VC in Central and Eastern Europe. However, only 11.4% of start-ups have managed to secure VC funds; while 30% rely on profits from service contracts.

BUSINESS ANGELS ARE THE MOST IMPORTANT SOURCE OF FUNDING FOR START-UPS IN BELARUS; 24% OF COMPANIES HAVE USED THIS TYPE OF FINANCING.

In 2017, Imaguru opened the Angel School, attended by 30 potential early-stage investors some of whom created the first BAN in 2018 (the first investment was made in the same year). BIF is also actively investing in early-stage start-up companies at the seed stage. Apart from direct investment, the fund has an innovation voucher system and grants up to USD 100 000 (sufficient in Belarus for proof of concept activity), earmarked for innovative technology with high market potential. The information about available finance for start-ups beyond this is hard to find.

In 2017, the first Belarusian VC, RBF Ventures, was opened as a Russian Belarusian JV with BYN 1.4 billion under management. The Fund has been formed by BIF and Russian Venture Company (RVC) to invest in technology start-up companies at the seed/growth stage. The financial regulatory and legal framework in the country does not yet include VCs, so the fund is regulated under Russian law. RBF have developed the national standard of VC financing for Belarus based on best international practices in project selection and deal structuring. The Development Bank of Belarus has been working to reform and simplify the regulatory system to allow further development of the VC industry and provide the legal basis for the status of an 'accredited' or 'sophisticated' investor, but this has not yet been implemented.

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Key points of technology transfer activity in the country

The government plays a more significant role in the regulation of all aspects of the economy in Belarus compared to most other European countries and the innovation process is heavily regulated and highly centralised. The TT policy implementation and state support for innovation are overseen by the SCST.

TT activities have historically been the remit of the NAS and their affiliated PROs, which are still the largest source of innovative technologies in the country. The current national TT system is weighted towards PRO-to-state industry transfer via several mechanisms, of which contract and collaborative research and know-how/trade secret transfer are the most popular. Ownership of the research results and the use/sale of IPR is permitted without restrictions in the private sector; in the public sector the ownership is automatically assigned to the PRO and the use of IPR is regulated by the state. Most universities and PROs have established IP policies with revenue sharing schemes, which are well regulated and harmonised with the WIPO university initiative. TT resources at PROs are available and TTOs are skilled in transfer to state-run industry but have limited knowledge in market research, technology appraisal for commercial potential, international commercialisation and identification of future technology trends.

THE INTERACTION BETWEEN THE PUBLIC AND THE PRIVATE SECTOR IS LIMITED DUE TO THE LACK OF PRIVATELY-RUN SMEs AND LARGE INDUSTRIAL COMPANIES.

Licencing to national companies is common if somewhat limited to state-owned enterprises; licencing to international companies is much rarer as it requires IP rights to have been awarded in a foreign territory and patenting abroad is rarely supported within PROs. Collaborative research with international companies and PROs is more common but, according to national registries of industry demand, which includes entries from foreign organisations, has been on the decline since 2014, and has not yet recovered.

The system of innovation funding is centralised and complicated with a low variety of financial instruments available to bolster innovation. However, limited specialised funding to promote TT (e.g. to increase TRL above 2 within a PRO or its affiliated techno-park, secure international patent application or obtain proof of concept, and support university-industry collaborations) is available from government sources. The regulatory and legislative framework is more inhibiting that catalysing but has been undergoing reforms to increase the incentives towards innovation activities. Although the national system of TT (including IPR protection and monitoring) has been brought in line with international standards and practices, it does not appear to perform well despite the adopted framework. The main challenge outside of general economic factors is the lack of in-country experience in TT (outside of the public sector) and technology translation, and the absence of functional commercialisation channels in public to private sector and internationally. As of October 2019, this was recognised at the government level as a countrywide problem.

The current practical implications of this challenge are::

- The trained TT personnel at PROs are largely limited to patent attorneys, economists, and accountants and only a limited percentage (~25%) of PROs have such resources on site.
- There is a lack of expertise in market research, commercial technology evaluation, brokerage and information disseminating on market demand and available funding in private and public sectors.
- There is a lack of dedicated resources for TT and, consequently, the lack of TT infrastructure and allocated staff positions, particularly technology commercialisation managers in regional PROs.
- The inventors are expected to be able to evaluate the commercial potential of their research results and identify the IPR protection measures without professional support.
- There is very limited understanding of the commercialisation process beyond state industry adoption within the planned economy. Belarus State University is the only PRO in the country who cite the creation of JVs as a potential commercialisation route for their technologies and the spin-off formation in universities and PROs is very rare.
- There is little to no involvement of HEIs and PROs in start-up activity. Many techno-parks' resident companies are either state-sponsored JVs or private sector start-up companies working on software development projects for international companies. The few success stories are limited to the ICT sector with low infrastructure and low upfront investment requirements.
- The VC and private equity (PE) financing channels are not available outside of initiatives supported by GSIP, BIF and its JV, RBF Ventures and the recently formed small BAN, which can only offer funding to a very limited number of start-up companies.

Additionally, less far-reaching challenges for TT identified are:

- The lack of basic TT education within the new generation of researchers. In the early 2010s, the formed compulsory undergraduate course "Basics of IP management" was downgraded to an optional course and now many HEIs no longer offer it to their students.

- The state regulation of the IP generated in PROs stipulates that the IP management and evaluation processes are focused on managerial principles (identify, file, account for in the balance sheets, monitor, depreciate, etc.) rather than on the principles of the financial benefit (profitability), economic benefit (contribution to GDP) or social benefit the invention can generate.

- The lack of unified documented policy of IP management and TT/commercialisation activities in PROs. The detailed understanding of the best practices in IP management and TT in the country and the harmonisation of these practices will be required to create a functioning instrument.

- The lack of support for patenting outside Belarus which results in (1) low numbers of European and international patents and trademarks granted (14 total granted between 1994 and 2018), and (2) declining numbers of Belarusian national patents as the inventors recognise that the low value of the national patent in the global market leads to disclosure of their invention to the international community without any benefit to them or their PRO.

Finally, the innovation activity of PROs in Belarus is noticeably distorted towards the incremental improvement of existing technologies at the expense of more disruptive innovation. The reason is likely to be the combination of low R&D funding from both public and private sources and the effects of 2014-2016 recession combined with the existing policy, which imposes the fine of the entire cost of technology development on the developer of the technology and the commercialisation partner if the technology has not been implemented in the industry within three years from its acceptance for commercialisation, or on the technology adopter if the technology has not been implemented in the industry within a year from the date of transfer (but not exceeding three years from the date of the technology acceptance for commercialisation). This policy, which seems to encourage the adoption of new technologies on paper, is, in fact, counterproductive as it imposes a high risk for both creation and adoption of disruptive technologies. It encourages 'safer' improvements on existing technologies, optimised production methods, or adaptations of the inventions developed and patented elsewhere over disruptive, highly innovative solutions, which is the effect that has been observed both during the literature review and in the field.

The government is taking steps that will lead to the reform of the IP policy and improvement in civil and administrative court procedures in 2020-2021, and in financial regulation and digital infrastructure in short to midterm. The institutional policy for NAS institutes-beneficiaries of the unified policy is expected to be developed in 2021. The government is also considering the measures that will increase the financing of R&D from the private sector and foreign entities and improve the position of Belarus in global innovation ratings.

RECOMMENDATIONS

The government is currently taking steps to improve the TT ecosystem in the country, create financial regulation and digital infrastructure, and consider measures to increase the financing of R&D. All these initiatives are expected to improve the effectiveness of TT activity in the country; however, it is not currently possible to make any specific comments to these policies and measures due to the early stages of development. A review of the proposed steps might be likely at the end of 2020 when the drafts are made if the SCST would consider sharing them with JRC (Joint Research Centre). To support the policy drafting process the Government could consider using a working group from PROs and enterprises to offer feedback on the effectiveness of new legislation. If doing this, the Government could review the example of Poland where PACTT (Polish Association of Centres of Technology Transfer) (Association of the Academic Technology Transfer Centers in Poland, 2019)) has this function alongside others. This association has emerged as a powerful 'sounding board' for national policymakers as they seek to improve the framework for TT in Poland. At this stage, based on the general findings of the team and the in-country interviews, a number of general suggestions can be made. These are limited to several key areas identified in this report as potentially having an adverse effect on the TT activity.

EDUCATION AND WIDER ENGAGEMENT

Improve the quality of education and public understanding of the IP management and TT by:

a. providing basic (school/bachelor's degree level) and additional (professional training and skills development) education modules in IP management in collaboration with WIPO as well as reintroducing the training "Fundamentals of IP Management" that was discontinued in 2014;

b. improving methodological support in IPR protection with a focus on software and algorithm protection and use of the IPR in ICT and OTT/digital media sectors;

c. developing methodological support for IPR protection covering specific sectors within the priority areas of V and VI technology paradigms to support the pivot within national industry;

d. improving the digital communication on availability of professional services in IP and innovation management to researchers and start-up companies located in techno-parks or co-working centres.

UNIFIED IP MANAGEMENT POLICY

Create a unified documented policy of IP management and TT in PROs. This solution is already under discussion, however, due to the importance of this measure, it must not be omitted from our recommendations.

BENCHMARKING

To encourage overall innovation process and benchmark the PROs by TT activity efficiently it might be helpful to collect the following additional metrics:

Knowledge transfer:

a. The number and value of research contracts between the PRO and enterprises;

b. Number and quality (impact factor) of publications resulting from collaborations with enterprises.

Research Commercialisation

c. The total number of start-up and spin-off companies created;

d. The total number of start-up and spin-off companies funded by the accelerator, incubator programmes in PROs or supported by techno-parks;

e. The total amount of funding attracted by the start-up/spin-off companies, including both internal and external funding i.e. European Commission (EC) funding, angel investment, venture capital, etc.

f. The number of start-up/spin-off companies that achieved a successful exit with the deal size indicated.

LICENCING FRAMEWORK

Improve the framework for licencing of state-owned IP to international organisations including the distribution of profits and responsibilities of organisations involved in the management of such transactions.

INTERNATIONAL PATENTING

It is recommended that the present system incentivising disclosure and patent filing, linked to institutional and individual ranking and career progression is revisited.

Stronger recognition of international patenting activity could be used to encourage more patenting for industrial purposes.

TWINNING PARTNERSHIPS WITH UNIVERSITIES IN THE EU

Alongside strengthening knowledge exchange with the Russian Federation and absorbing their experience in developing IPR policies and integrating VC models into post-Soviet structures, similar relationships could be developed with the EU in the education sector. In particular, the concept of entrepreneurial universities[5] e.g. the University of Zagreb as drivers of innovation and entrepreneurial activities could be considered. This will allow for improved success rates in Horizon 2020 and its successor programmes. Such an initiative could be supported initially by a specialised grant from the Ministry as part of their policy incentives mix.

PRO-TO-PRIVATE SECTOR TECHNOLOGY TRANSFER

Outside of general economic measures to encourage the growth of the private sector, increased PRO-to-private sector TT can be achieved by creating:

a. a platform for information exchange on start-ups' needs for PROs' R&D services e.g. prototyping, etc.

b. improved frameworks for licencing of the IP from PROs to start-up companies.

However, without more favourable economic conditions for private enterprises (start-ups, SMEs, and large companies) the measures suggested above are likely to be ineffective. Such measures could include universal tax relief, a tax credit scheme for private R&D companies with high innovation impact or a capital gains relief for institutional and private investors with early-stage technology portfolios.

FUNDING OPTIONS

Increase the operations allocation for regional TTOs via deployment of extra-budgetary funds to enable:

a. increase in the number of qualified TT managers with market research skills in PROs and number of PROs where such specialists are employed as permanent members of staff;

b. inventor incentivisation through reliable career progression and professional recognition rather than administratively managed 'premium' measures;

c. incubator and accelerator programmes at regional PROs to encourage and support creation and development of independent commercial companies capable of growing into SMEs in the future;

d. increase in financing available for TT centres earmarked for international patenting within PROs. It is recommended that the selection process for technologies allowed to progress beyond the national stage is focused on the assessment of the wider technological and commercial potential of the invention rather than its economic or social benefit identified within the national economic system.

Create more favourable economic conditions and the regulatory framework to encourage the growth of the VC industry in the country and increase the availability of private funds for innovative technologies. This can be achieved by creating a state-run VC initiative along the lines of Israel's Yozma who leveraged public money to attract private investment and transformed the country into a global R&D hub in the 90s. Yozma added 40% to the funds offered by private investors for three years, supporting more than 40 companies and increasing its value by 2.5 times in the process. Yozma was created when Israel was disproportionately reliant on government funds and is a rare example of government VC success. It is very likely that such success is possible to replicate in the centrally-run environment with strong industrial potential and high availability of scientific and developer talent.

Create the framework for the VC industry to invest in technologies originating from PROs to help create spin-off companies. This can be structured as a deal with a PRO rather than individual researchers e.g. by providing investment for specific research groups or departments in exchange for granting those investors equity stakes in the spin-off companies. A similar approach was used by Beeson Gregory/IP Group in a deal with Oxford University where they invested into building a new chemistry department in 2000 and could be used in Belarus if we take into account the early success of the GSIP.

While the measures suggested above are likely to increase the TT and innovation activity in the country, improve the quality of R&D and of patented inventions, their alignment with global trends will additionally require an increase in public R&D expenditure and in demand for new technologies within industry.

TOLERANCE TO RISKS IN R&D

Currently, the tolerance to technological risks is quite low and is defined by the state policy (Decree of the President of

5 An entrepreneurial university can be any university that contributes and provides leadership for creating entrepreneurial thinking, actions, institutions and entrepreneurship capital.

the Republic of Belarus, 2013). Attempts to introduce technological risks for R&D projects have so far failed as supervisory authorities are guided by the Budget Code where the risks are not tolerated, and not by the Civil Code, where the risks are permitted. The penalties levied on both PRO and their industrial partner in case of unsuccessful or partially successful commercialisation within the defined period (usually three years) reduce the level of invention and discourage development and commercialisation of highly innovative disruptive technologies, which by definition, do not fit into the established industry processes and often require longer adoption periods.

Another important aspect of the same policy is the additional penalty levied on a PRO in cases of failed commercialisation – to grant the free exclusive perpetual licence of the failed technology to the state-owned industrial partner within one month after the end of the commercialisation period. An industrial partner in the same position has three months to transfer the IPR as a non-exclusive licence to another *Belarusian organisation*. This suggests that the law is weighted against the PROs as the PROs not only repay the grant but also lose all rights to the developed IP. In addition, this policy might prevent developing the technology further as, without the PRO, the industrial partner is unlikely to complete the R&D required for the manufacturing stage. The policy does not allow international commercialisation of the technology failed in the domestic market, which means a loss of a commercial opportunity for both the PRO and the state.

Such draconian measures reflect the position of the government: those who cannot guarantee the results within three years should not apply for the public funds. In practice, the Decree No.59 could be better used for the purposes of the state controller analysing the effectiveness of the use of public funds within the PROs rather than to penalise the PRO or the domestic technology adopter. Such a policy has already led to many R&D organisations (HEIs, PROs, enterprises) not using the state funding programmes, which lead to a declining number of high-quality innovative projects under development and the underuse of funds even under the conditions of significant financing deficit. It is recommended that the effect of this policy on the quality of innovative technologies is studied in more detail and, if its detrimental effect is confirmed nationwide, the policy is redrafted to allow risks.

COOPERATION BETWEEN THE STATE AND THE PRIVATE CAPITAL

In order to develop an innovative component of the economy it is necessary to strengthen cooperation between the state and private capital, HEIs and PROs with industry and business, especially with SMEs, and further develop the conditions and incentives for the creation and use of IP. In Belarus, such measures are most likely to create a high ROI as the country has strong advantages: high standards of education, the significant talent pool in high tech areas proven by world-class success stories of several start-ups, well developed industrial base and the centralised regulatory system that allows fast and efficient implementation of reform and the distribution of funds.

One of the early test grounds for the success of the government reform focused on the development of a favourable financial framework for innovation is the GSIP, expected to become a modern international eco-city with an emphasis on producing high tech/innovative products with high export potential in the duty-free Eurasian Economic Union (EEU) market and neighbouring European countries. For the Belarusian government, the creation of this industrial park might trigger the upgrade of its national economic model. In 2018, the government classified the GSIP as a "territorial special economic zone (SEZ)" providing the GSIP with the most favourable economic conditions in the country until 2062. JV funds are being created to provide financial support e.g. the Park has its own USD 20 million investment fund to finance start-ups, and China Merchant Group created a USD 600 million fund on the Cayman Islands to support business development, currently at the end of the fundraising stage. The completion of the first stage of the park infrastructure is expected in 2020, and the park already has resident companies. The park will become fully operational in 2030 upon the completion of the construction period.

However, despite all these developments, in 2019, access to finance remains constrained for the park resident companies due to a combination of the lack of long-term funding, high-interest rates and stringent collateral requirements demanded by local legislation. Both VC funds associated with the park are of limited availability at the moment. The need for trusted and already-implemented mechanisms remains. European Bank of Research and Development (ERBD) in their 2018 report (Kolkin, 2018), suggested, for example, that the ability of resident companies to own land offers more opportunities for collateralisation and the difference could be made by development banks customising existing financial instruments to provide long-term debt and equity financing to local and foreign investors in GSIP. The financial instruments used successfully in the GSIP could be used in other techno-parks in the country, attracting private capital and foreign investment and facilitating rapid development of start-ups and SMEs in high tech sectors.

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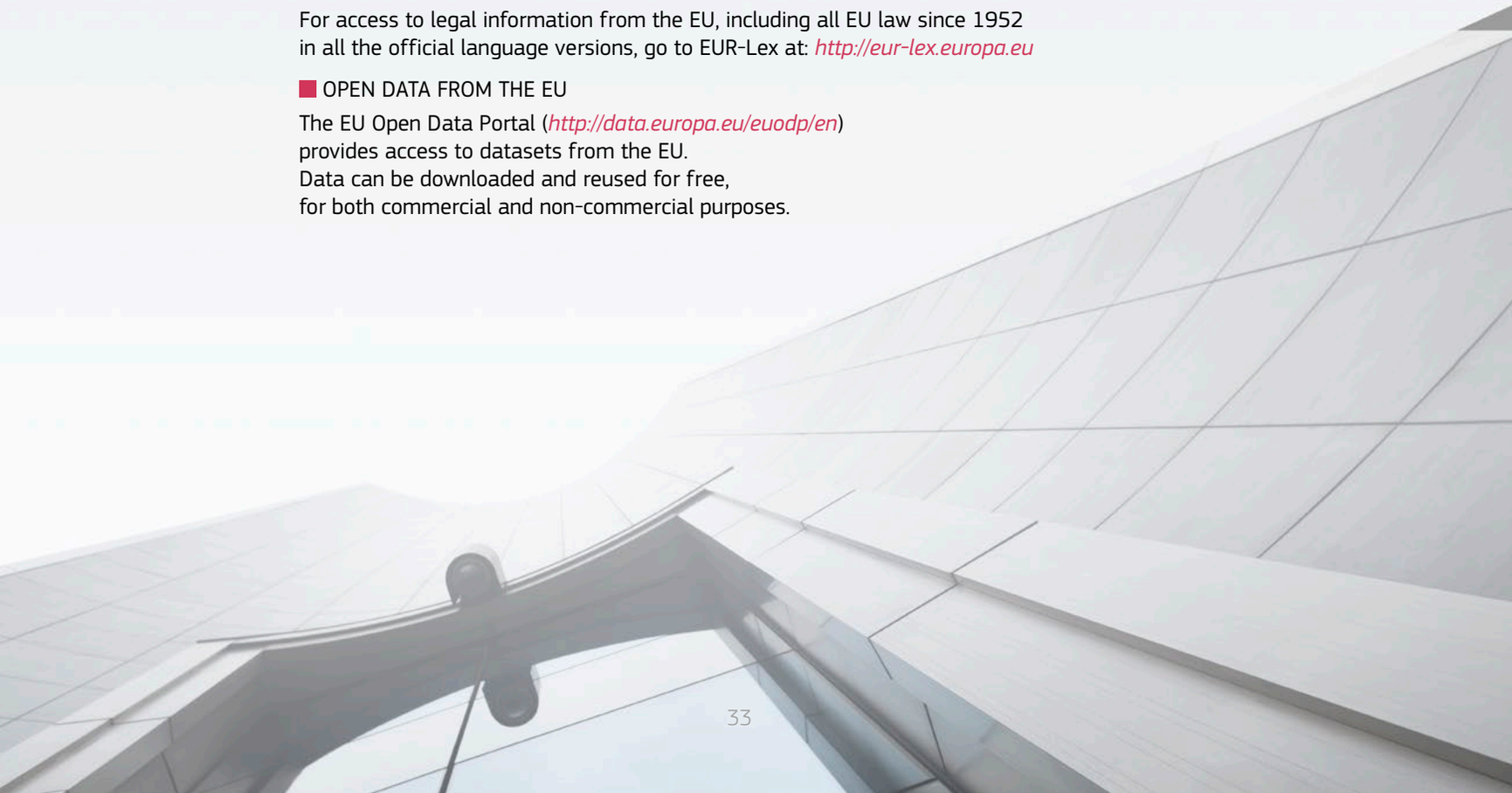

Acronyms

AI	Artificial intelligence
BAN	Business Angel Network
B2B	Business-to-business sales model
BIF	Belarusian Innovation Fund
BNTU	Belarusian National Technical University
BOIR	Belarusian Society of Inventors and Innovators
BSU	Belarusian State University
BYN	Belarusian ruble
CIS	The Commonwealth of Independent States
EAPO	Eurasian Patent Office
EBRD	European Bank of Research and Development
EC	European Commission
EEU	Eurasian Economic Union
EU	European Union
GDP	Gross domestic product
GSIP	Great Stone Industrial Park
HEI	Higher education institution
ICT	Information and communications technology
IoT	Internet of Things
IP	Intellectual property
IPR	Intellectual property rights
IT	Information technology
JRC	Joint Research Centre
JV	Joint venture
NAS	National Academy of Sciences
NCIP	National Centre of IP

OTT	Over-The-Top (technologies)
PACTT	Polish Association of Centres of Technology Transfer
PCT	Patent Cooperation Treaty
PE	Private equity
PRO	Public research organisation
R&D	Research & development
RBF	Russian Belarusian Fund
RCTT	Republican Centre for Technology Transfer
ROI	Return on Investment
RVC	Russian Venture Company
SaaS	Software-as-a-Service
S&T	Science & technology
SCST	State Committee of Science and Technology
SEZ	Special economic zone
SME	Small and medium enterprise
TRIPS	Trade-Related Aspects of Intellectual Property Rights
TRL	Technology readiness level
TT	Technology transfer
TTO	Technology transfer office
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
USPTO	United States Patent and Trademark Office
VAT	Value-added tax
VC	Venture capital
WIPO	World International Patent Organization

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