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JRC126057


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ACKNOWLEDGEMENTS

The JRC's Competence Centre on Technology Transfer would like to express its gratitude to all organisations, experts, managers and practitioners who have contributed and participated in this study.

JRC would also like to thank all respondents of both the online questionnaires and the personal interviews for sharing valuable information on technology transfer ecosystems.
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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

One of the country’s top priorities under the scope of the National Research, Development and Innovation Program (NRIP) for 2020-2023 is to change its economic growth model and become an economy based on competitiveness and innovation. There are several government strategies aimed at reforming the public sector to better support innovation in Moldova. However, better coordination between the strategies, definition of the roles that stakeholders can play in delivering those strategies, and focus on the way of direct support of the ecosystem development is needed.

Even though Moldova has a relatively well-regulated framework of Intellectual Property (IP), coordinated by the State Agency for Intellectual Property (AGEPI), implementation of legislation is challenging mainly because of the coordination of enforcement agencies, staffing, the training of enforcement bodies, and the existence of awareness-raising initiatives, among others.

Universities and research organisations

Research & development (R&D) activity is highly fragmented not only institutional-wise but also geographically: in 2018, 40 institutes and research centres and 17 higher education institutions concentrated the R&D activity. Among these, 51 institutions were state-owned.

Most of the patent applications are submitted by universities and R&D centres, and actions are being taken to encourage the creation, protection, and usage of IP. Nonetheless, even though some universities have defined a R&D strategy and structures, they are more educational centres rather than Research & Innovation (R&I) hubs. There is also a low applicability of registered inventions in the country due to the fact that public R&I is not sufficiently oriented towards the country’s economic and societal needs.

Technology transfer (TT) for universities and research centres is still at an early stage of development, which makes up another stumbling block for successful collaboration at the national level between the scientific community and the business environment. Researchers are solely responsible for the commercialisation of their results. Therefore, as a result of this lack of skills and knowledge about the TT process, the Moldovan community’s scientific results are often simply published without considering their application value.
Support organisations

Incubators, science and technology parks (STPs), Business Angels (BA) networks, co-working spaces and other support infrastructure form a reinforced network of support organisations in the country. Some issues concerning the availability of appropriate finance for the life cycle of innovation, starting from seed funding needs, angel investment, Venture Capital (VC), equity finance, up to crowdfunding, are still present.

Industry

A weak business culture, bureaucracy, taxation, barriers to market entry, and an insufficient investment and infrastructural support hinder the efficient development of a national spin-off and start-up ecosystem.

A low IP awareness and capacity for IP protection are negatively affecting the competitiveness of Moldavian small and medium enterprises (SMEs) and TT between the business sector and public R&D. National SMEs lack a coherent IP management strategy and they neither have the necessary knowledge to develop and manage their IP portfolios nor an entire understanding about the IP rights system.

The share of innovative companies in the total population of SMEs in the Republic of Moldova is minimal. There is an observed skills gap nowadays in many areas that could drive the economy, especially in R&D, which stems from high emigration and brain drain (HiQStep, 2018).

Technology transfer

The main support for public-private knowledge transfer and stimulation of innovation activities is provided by the National Agency for Research and Development (NARD), which encourages companies to transfer innovations to market through grants and facilitates relationships between researchers, universities and industry representatives. However, NARD is highly focused on PROs as opposed to existing businesses. Insufficient funding from the state budget and low contribution of the private sector to the development of science and innovation results in low absorption of new technologies by the business environment.

TT is still at an early stage of development in Moldova despite being included in the national development strategy. The TT system lacks funding, a proper innovation infrastructure as well as specialised research staff positions. There is no obvious evidence of actual TT resulting in licencing or sale of IP. As a result, there are few joint initiatives projects with businesses and companies.
GENERAL FINDINGS

Government

Relation of technology transfer with national economic strategy

Moldova is a lower-middle income country, with a largely factor driven economy, especially focused on agriculture and remittance driven consumption. It has about 4 million inhabitants and a Gross Domestic Product (GDP) per capita of USD 7,304.5 (2019). Research and development expenditure (% of GDP) in Moldova was reported as 0.25% (2018) and 0.2% (2020), with the target set at 1% GDP. According to the official data presented by the National Bureau of Statistics (NBS), a citizen of the Republic of Moldova earned on average MDL 7,633.9 per month or about EUR 390 (gross amount) at the beginning of 2020. Connections to international free trade agreements, especially the Commonwealth of Independent States (CIS) and European Union (EU) are critical supports to the economy (UNESCO, 2017). The Moldovan economy is built on the agricultural sector, which represents 15% of GDP and 45% of commodity exports. Besides agriculture, Moldova concentrates its economy on manufacturing, services and trading.

A promising emerging innovative sector for the country is Information and Communication Technologies (ICT), which has gained strategic economic importance similar to that of other CIS countries.

Moldova has a relevant tradition of education and research. However, cuts in education and research funding led to very low investment in these sectors since 1990. No longer integrated in the much larger network of the Soviet Union, Moldovan research significantly declined in its size, quality and outcomes. However, niches of excellence were preserved (Räim et al., 2016).

‘MOLDOVA 2020’ National Development Strategy, approved in 2012, stipulated that the paradigm of economic development during the Strategy’s implementation will imply attracting investments, developing export industries, promoting a knowledge-based society, by strengthening research and development, innovation, and technology transfer activities focused on effectiveness and competitiveness. However, despite this goal, the research and innovation system is underfunded, fragmented, and unsynchronised with the sectors of the economy that produce goods and services (Republic of Moldova, 2019).

An analysis of the expenditures for research and innovation activity covered by the 2018 National Public Budget shows that only 3.1% of them were oriented towards capital investments, while the remaining 96.9% were current expenditures. Compared to 2017, MDL 31.8 million (7.9%, respectively) more funds were spent for research and development activity in the public sector (Räim et al., 2016). In 2020 total budget for R&D is MDL 500 million and this trend is likely to continue in the future despite the damage caused by the global pandemic.

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Recent changes in approach can be seen in the National Program for Research and Innovation (NPRI) for 2020-2023, which starts from the premise that research and innovation expenditure should be considered as national investment rather than budgetary expenditure.

**Relation of technology transfer with national regulatory framework**

For several years the Moldovan Government has been seeking to change its economic growth model and become an economy based on competitiveness and innovation. To adopt a more open model, the objective of reforming the governance of the national system of scientific research, technological development, and innovation was introduced into the Action Programme of the Government of the Republic of Moldova for 2016-2018.

In 2017 it was decided to reform science and innovation in the country, focusing on increasing the efficiency in this field and increasing the impact of research and innovation on the national economy.

The main public authorities in innovation and technology transfer are:

- The Ministry of Education, Culture and Research, responsible for developing public policies in the field of research and innovation;
- The National Agency for Research and Development, NARD, implements the state policy according to the Action Plan approved by the Government to implement the NPRI and sectoral strategies.

NARD manages the budget approved for funding R&D and innovation projects, in line with the regulatory framework and monitors implementation;

- The Academy of Sciences of Moldova, an autonomous public institution of national interest in R&D, operates on the principles of self-management, and acts as a scientific consultant for the public authorities in setting the priorities in the field of fundamental and applied research (Popa, 2011).

- The State Agency for Intellectual Property, responsible for promoting and executing activities in the field of legal protection of intellectual property regarding industrial property rights, copyright, and related rights (Stratan et al., 2018).

The National Programme in Research and Innovation and the Action Plan for its implementation are the main policy documents through which the Government sets out priorities and strategic directions for development in research and innovation for the period 2020-2023. Other main legislative acts aimed at stimulating the development and implementation of innovations are The Code on Science and Innovation of the Republic of Moldova and the Law on ST Parks and Innovation Incubators. In addition to the legislation and the basic documents, which directly address the sphere of innovation, several policy documents influence, to a certain extent, the field of innovation, of which the main are: The National Roadmap for the Integration of the Republic of Moldova into the European Research Area for 2019-2021, the Methodology of Funding Projects in the Field of Research and Innovation, the Methodology of institutional funding of public research and innovation organisations, the Roadmap for improving the competitiveness of the Republic of Moldova, National Action Plan for the Implementation of the Moldova –EU Association Agreement for the period 2017-2019, National Intellectual Property Strategy until 2020, the SMEs Development Strategy, the Concept for the Development of Industrial Clusters in Moldova and the National Regional Development Strategy, Research and Development Strategy of the Republic of Moldova until 2020.

It was suggested that these strategies could be better coordinated with one another and oriented to what roles individual stakeholders can play in delivering these strategies and how the strategies can more directly support the ecosystem. They should explore the specific potential advantages the ecosystem has and how reforms can meet the needs of domestic stakeholders.

**Relation of technology transfer with the national IP regulatory framework**

The national system dealing with intellectual property consists of the AGEPI, the body of authorised mandatories in the IP field – an indispensable element of all national IP systems, the evaluators of IP objects, the organisations for collective management (OCM) of patrimonial (inherited) rights, the information and consulting centres (specialised information, consulting, and specialised assistance – AGEPI: the National Collection of documents in the IP field, free online access to local and foreign Official Bulletin of Industrial Property). The legislative framework for intellectual property in the Republic of Moldova includes seven special laws regarding the protection of industrial property objects, copyright and related rights, which is in accordance with EU and other international laws and the conventions, treaties, and international accords in the IP field in which the Republic of Moldova is a signatory (Bulimaga & Balmus, 2016).
Even though in the period 2007-2010 the regulatory framework related to IP was revised and six special laws were harmonised with EU legislation, its implementation is a critical factor.

The country has experienced difficulties due to inadequate coordination of enforcement agencies, staffing, and other resource constraints including funding, the continued need for training of enforcement bodies and awareness-raising initiatives, and the absence of sufficient engagement of right holders in the enforcement effort (Räim et al., 2016).

Universities and public research institutions are a part of the national IP system and have a special contribution to it. The national strategy for IP defines a special place for these institutions, investing them with several responsibilities including encouragement in the creation, protection and use of IP and promoting innovation in society (Bulimaga & Balmus, 2016). Nevertheless, there are a small number of renewed patents (less than 1/3 had a duration of over 5 years). This is partially due to a 5-year remission from taxes, which applies to Moldovan researchers. Other reasons are the low applicability of registered inventions (determined by the profile of the Moldovan economy), the weak links between business and R&D sectors, and low culture of innovation. The number of patent applications at foreign patent offices is marginal (Bulimaga & Balmus, 2016).

As for the promotion of technology transfer, reportedly, the key initiative of the AGEPI has been the delivery of some training and awareness-raising events to universities and businesses together with the World Intellectual Property Organization (WIPO).

Funding and commercialisation

The funding of science and innovation activities according to the priorities of science development, approved by the Parliament, is done in an institutional and competitive system: for institutional projects, state programmes, projects for young researchers, bilateral topics and projects, and innovation and technology transfer projects (MDL 8 million in 2020) (Tempus Projects, 2015). As the NBS does not capture indicators of innovation funding, it is difficult to estimate the volume of innovation funding and to assess the balance between research and innovation funding. Only the NARD budget is assigned exclusively to the promotion of innovation. However, NARD funding does not exceed 5% of total R&I funding from public sources. The majority of support measures target PROs and only few stimulate business R&D and innovation activities. Private firms are practically excluded from governmental funding for R&I. A regular evaluation and benchmarking of funding schemes is not carried out. Some innovation activities are funded by the MEI, most of them through the Organization for Small and Medium Enterprises Sector Development. Bank financing remains the main source of external funding for companies, particularly for SMEs with growth needs which cannot be covered by microfinance (Tempus Projects, 2015). Funding for innovation through venture funds, or other similar instruments able to stimulate innovation in the private sector are not yet well-developed. Development of a law on venture funds and for support for linking Moldovan SMEs with funders and business angels is in the planning stage (pre-draft). State and externally funded innovation and technology transfer projects are useful tools for stimulating innovation in SMEs by partially absorbing the risks related to the innovation process. At the same time, they act as a form of transfer of new technologies from the national institutions of science and innovation to businesses (nationally and internationally) and application at industrial level, leading to the development and extension of businesses.
Universities and research organisations

Several ministries deal with R&D and innovation related issues: Ministry of Finance, Ministry of Economy and Infrastructure, Ministry of Agriculture, Regional Development and Environment, Ministry of Health, Labor and Social Protection, and Ministry of Education, Culture and Research. The R&D activity in 2018 was carried out within 64 units, including 40 institutes and research centres, 17 higher education institutions. Out of the total number, 51 units or 80% are state owned. The fragmentation is observed not only institution-wise, but also there is a geographical divide in the area of influence of R&D&I (Research & Development & Innovation), Development stakeholders and innovators. Out of 44 institutions accredited by CNAA in 2020 to carry out R&D activities, 40 were located in the capital – Chisinau, and the other four were in the other regions (Spiesberger & Cucureanu, 2015).

As of 31 December 2018, 4,451 employees were carrying out R&D activities, less than 5.2% compared with the situation at the end of 2017. More than two thirds of the total number of employees have been working full-time. The distribution of researchers by age group shows that the highest proportion is represented by researchers over the age of 65 (23%), and the smallest is made up of those in the 45-54 age group (17%), which could be a consequence of the severe brain drain in the 90s.

These issues certainly affect negatively the innovation ecosystem of Moldova, because without enough researchers, especially ones oriented towards finding solutions for industry needs, continuous technology transfer cannot occur.

Regarding the expenses, in 2018, the expenses incurred in the state owned units constituted 89.4% of the total expenses for the R&D activity. Compared to 2017, MDL 31.8 million more were spent in the public sector. Out of the total current expenses, the expenses on personnel predominated with MDL 329.6 million (or 70.2%), an increase of MDL 21.6 million compared to 2017. In 2018, MDL 13.3 million (88.7% of capital expenditures) were invested in scientific equipment and infrastructure, which is MDL 2.8 million less compared to the previous year.

Also, of the total current R&D expenses, 54.6% were dedicated to applied research, 28.4% to basic research and 17.0% used for technological development. Compared to 2017, the share of current expenses for basic research registered an increase of 2.4%, while for technological development and applied research decreased by 1.8% and 0.5% respectively.

To overcome these issues several initiatives have been implemented. First, to prepare specialists in technology transfer and innovation management, a Master's level course “Innovation and Technology Transfer Management” was developed in a partnership between the Moldova State University, the Technical University of Moldova (TUM), State Agrarian University of Moldova and State University “A. Russo” from Balti. This course was the result of a pilot programme implemented under the TecTNet Project “Technology Transfer Network”, a project funded by the EU under the TEMPUS programme. The course was launched on 15 September 2014 and it lasted 18 months.

Unfortunately, the competencies produced by the educational system currently in place are not sufficiently meeting the needs of the private sector, and there is a lack of critical mass in key skill sets.

18 MSc graduated from this programme during the TecTNet Project. In addition, during the Tempus project TecTNet four universities established Technology Transfer Offices (TTO): TUM, Moldova State University, State Agrarian University of Moldova and State University “A. Russo” from Balti. Afterwards, the TTO from the TUM was transformed into a start-up accelerator specialised for IT within the project Tekwill. Unfortunately, the only currently active TTO from this project is the one from Moldova State University.

Other universities or institutes do not have the commercialisation support structures required to promote the commercialisation of IP rights, such as TTOs, technology incubators, prototype development facilities, or science and industrial parks. Commercialisation of research results in Moldova is largely left to individual researchers.
IP policy

The rights to IP developed in the universities are regulated according to the legislation of the Republic of Moldova\(^3\). The amount of remuneration between owners and inventors/authors, the time, and the payment method can be negotiated, considering the actual or alleged profit given by the use of the IP objects created within the performance of duties during the validity of the protection title, independently of work relationship or relationships that are established in another contract between employer and author (or co-authors). By law the amount of the remuneration must constitute at least 15% of the gross income and must be calculated and paid to the author (or co-authors) no later than the end of each year of exploitation. The author (or co-authors) has/have the right to be remunerated even in the case where the employer or beneficiary concedes the rights to the IP created within the performance of duties. Thus, the remuneration is provided by the new owner of the IP (Bulimaga & Balmus, 2016). As of the time of writing, only Moldova State University has an internal IP policy to regulate ownership and benefit-sharing. Installing adequate IP policies at other Moldovan universities and PROs would certainly contribute to the strengthening of a currently weak entrepreneurial and research commercialisation culture.

Contract research/ Collaboration with industry

As it was highlighted by several stakeholders from the business sector, the public R&I sector is not producing sufficient research results relevant to companies or is not working with business on joint innovative projects. This is probably because public research is still more focused on fundamental (basic) research and is not yet sufficiently oriented towards the economic and societal needs of the country. Besides, prerequisites for successful cooperation such as a favourable legal environment and support for spin-offs from research organisations and universities, and new start-up firms, and efficient technology transfer infrastructure are currently missing.

The main support for public-private knowledge transfer and stimulation of innovation activities is provided by the NARD.

The approach is bottom-up, covering a very broad spectrum of thematic fields. The projects are supported for a two-year period and require co-funding from non-public sources of at least 50% of the total budget. However, the overall budget for such projects amounts approximately 2% of the state budget for R&I, with a total of approximately MDL 8 million for 2020. Such figures are insufficient, as is widely recognised in the country.

For the stimulation of business innovation several useful measures were highlighted in the National R&D strategy (2014), the Innovation Strategy (2013), and the SME Strategy for 2015-2017 (e.g. making public R&D funding accessible to business, diversifying financial innovation support instruments via innovation vouchers, etc.).

Due to the lack of dialogue between representatives of the scientific and research community and the business environment at the national level, research results are insufficiently implemented in practice and new technologies are not absorbed by businesses (also internationally). According to the data of the ‘2015-2016 Innovation Activity of Enterprises in the Republic of Moldova’ study of NBS, under the cooperation on the innovation of products and processes, only 13% of innovative enterprises indicated universities and research institutions as cooperation partners, 28% indicated equipment, materials, components or software providers as cooperation partners, 26% – other enterprises and 25% – clients or buyers (Räim et al., 2016).

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\(^3\) Government Decision of the Republic of Moldova No. 1609 of December 31, 2003, on approving the Regulation on intellectual property objects created within the performance of duties, Government Decision of the Republic of Moldova No.041 of July 12, 2003, on the minimal author remuneration rate.
Faculty and researchers

Based on the declining number of PhD students in Moldova, it can be concluded that the research career is not at the top of young people’s preferences. In 2018 there were 1,569 PhD students, which is about 50 and 100 persons less than in 2017 and 2016 respectively. In addition, the number of researchers per million inhabitants is 4.5 times lower in the Republic of Moldova than the European average. Other observed phenomena that influence negatively the quality and competitiveness of research produced in the country are emigration and the increase of the average age of active researchers: in 2017, about 22% of researchers were aged 65 and over, and in 2018 this weight reached 23% (Republic of Moldova, 2019).

The limited available human and financial resources in Moldova have obvious repercussions on the quality and excellence of knowledge production. In Thomson Reuters (ISI) Web of Knowledge, the performance of the national R&D system is fairly low and, according to the number of publications per million inhabitants, the indicator for Moldova is six times lower than the average for new EU members and 15 times lower than the overall EU average. International cooperation is particularly important here, as about 70% of papers of Moldovan researchers have co-authors from abroad (Spiesberger & Cuciureanu, 2015).

Another problem is that the scientific results obtained by the Moldovan community are simply published without further consideration of their application value in the market. The interviews for this study highlighted that a culture of applied research and technology transfer have not yet spread among researchers. Efforts are directed towards knowledge production for publication, as this is the way to obtain merit to advance in a scientific career. Researchers publish full theses on the website of the CNAA, regardless of the field and practical value of the data which may diminish the possibility of securing a patent or other type of protection. Possible objects of intellectual property that might have commercial interest for the business community, including western companies, are not considered (Tempus Projects, 2015).
Industry

In the Republic of Moldova, SMEs embody the most important part of economic agents, representing, according to the NBS, 98.7% of the total number of enterprises in 2016. Until recently it was not possible to analyse the activity of innovative SMEs due to lack of the statistical data. Starting in 2017, the NBS presented for the first time information on business innovation activity in the Republic of Moldova for the years 2015-2016. Based on the published information, it was found that (Stratan et al., 2018):

- SMEs are more innovative than large enterprises. The share of innovative SMEs in total innovative enterprises in the Republic of Moldova in 2016 constituted 90%. The share of innovative SMEs in the total SMEs in the Republic of Moldova is extremely small (only 1.2%). Thus, out of 51,626 SMEs, only 609 were innovative.

- There are more innovative SMEs in industry than in services sectors. Innovative SMEs in the industry sector accounted for 52.4% of all innovative SMEs.

- SMEs from industry have earned higher income from innovation activity than SMEs from the services sector.

The most innovative SMEs are concentrated in Chisinau (58.6%) and in the Centre (16.1%) and Northern (15.1%) development regions. The Southern Region and ATU Gagauzia has registered a relatively smaller share of 6.6% and 3.6% respectively of all innovative SMEs (Crudu & Petrici, 2017).

Still, the private sector in Moldova is not an active beneficiary of R&D funding considering that most policies and existing schemes do not target research in private companies. Also, the SMEs’ low awareness about the effects of innovation on a company’s development, and limited financial resources, etc. is affecting cooperation between businesses and research and innovation institutions. To overcome existing limitations, a positive innovation support measure was introduced in 2007 with the Law on Science and Technology Parks, and Innovation Incubators. As a result of this law, three scientific-technological parks, as well as seven innovation incubators were operational in 2014. The firms that operated in techno parks and incubators would benefit from fiscal incentives, low tariffs on leasing of premises and public utilities. Additionally, the intellectual property agency AGEPI would cover 95% of their patenting costs. Notably, tax incentives were introduced by law but never applied, and are currently being phased out. However, in 2018 a new Law on Science and Technology Parks and Innovation Incubators was adopted, according to which, STPs and incubators became self-funded. This change caused a lot of challenges and as a result of it, the majority of STPs and incubators now exist just formally (on paper), without any activities.

As already mentioned, the main support for public-private knowledge transfer and stimulation of innovation activities in SMEs, is provided by the NARD through its annual call for Innovation and Technology Transfer Projects. Innovation Vouchers were implemented and supported in Moldova only in 2015, and they proved to be a useful tool for SME-research cooperation.
Despite the rather well-developed IP framework in Moldova, the lack of awareness of IP rights is a major stumbling block for SMEs.

They do not fully understand the IP rights system and the need for resources for the proper protection and enforcement of intellectual property rights. Therefore, SMEs often lack the necessary knowledge to develop and manage their IP portfolios and they often do not have a coherent IP management strategy crucial for increasing their business. These issues are especially detrimental when SMEs operate in international markets with different national IP systems.

On the national level, the mechanisms that regulate the sharing of rights and benefits among authors/inventors needs improvement, especially in cases involving co-financing from the private sector.

Furthermore, there are no clear criteria for awarding the qualification “innovative enterprise”, and the SME patenting activity of inventions is still extremely low compared to trademark registration and industrial design. The still developing innovation infrastructure and the weak cooperation between the private sector and public R&D is reflected in a small proportion of patents registered and/or renewed in Moldova, filed by business enterprises and organisations (Crudu & Petrici, 2017; HiQStep, 2018).

Clusters
The development of clusters in Moldova originated from the needs of the industrial sector. An array of clusters now active in Moldova are focusing on cross-innovative areas, such as nanotechnology and new materials, food processing and applications of renewable energy technology in agriculture.

International experience shows that cluster formation and efficient implementation can address certain areas that are crucial for Moldova (improvement in quality of goods and services, enhanced readiness for export, capacity building for human resources and skills upgrade). In Moldova there are pre-conditions for cluster development considering the existence of relevant policies and support from international donors, financing sector-specific initiatives. The existing clusters are still relatively small and focus on collaborative R&D activities while there are still no strong clusters formed in strategic industries for the country, such as wine, automotive, ICT, light industry (HiQStep, 2018).
Support organisations

The main builders of the innovation ecosystem in Moldova are (HiQStep, 2018): co-working spaces (‘404 not found’, Generator Hub, Dream Ups, ArtCor, iHub, Digital park), fablabs, high-tech parks (Digital Park Starnet, Moldova IT Park (virtual), scientific-technological parks (Technopark Academica, Technopark Inagro, Technopark Micronanoteh, NARD), incubators (Inovatorul, Politehnica, Nord, Innocenter, Inventica-USM, Antreprenorul Inovativ, Media Garaj, etc.), accelerators (XY Accelerator, Dreamups, YepMoldova (Garage 48), ZipHouse, Upcelerator.md), BAs Moldova network, Moldovan Technology Transfer Network, EEN Network, and business associations.
Key points of technology transfer activity in the country

Government

- In the case of the Republic of Moldova, technology transfer is still at an early stage of development, although it is included in the state action plan. Modest results compared to other states in the region are due to the lack of sufficient funding, innovation infrastructure, and research staff.

- There are a number of strategies aimed at reforming the public sector to better support innovation in Moldova. However, these strategies could be better coordinated with one another, and oriented to what roles other stakeholders can play in delivering those strategies and how the strategies can more directly support the ecosystem.

- Lack of a clear understanding of the priorities for the development of innovation policy, both at the national and regional level, fragmented policies, and lack of implementation of policies is present.

- A modest role is assigned to the research and innovation activities under the public policy system.
• R&I needs to be better linked with the socio-economic developments of the country and better embedded in Moldovan policies aimed at those developments.

• The majority of support measures taken so far for improving the R&I capabilities of Moldova are targeting PROs (supply-side of innovation) and only few stimulate business R&D and innovation activities (direct funding for business R&D and demand-side measures).

• Smart specialisation is a step forward in creating national research and innovation strengths, and correlating them with the needs of the business environment.

• A value chain from “knowledge to market” is not complete nor inter-connected.

• Brain drain is an issue in Moldova. Many young highly educated talented people are emigrating to find jobs in companies, universities and research institutions abroad.

• The exploitation of patents in Moldova is also weak compared to the world average (7 to 8%). Such low numbers could also be attributed to the inadequacy between research orientations and economic strengths of the country.

• Low awareness, knowledge and capacity to protect IP are serious issues that are affecting competitiveness of Moldovan SMEs and technology transfer between the business sector and public R&D.

• A favourable legal environment and support for spin-offs from research organisations and universities is missing.

• Weak business culture, bureaucracy, taxation, barriers to entry and an insufficient investment and infrastructural support, affect negatively successful establishment of a start-up in Moldova.

Universities and research organisations

• Strong decline in R&D personnel is largely due to the very low funding of the R&I system over the past 25 years, and to the poor conditions in terms of careers and salaries of national researchers.

• The mission of universities is primarily focused on education and teaching, while research activities and links to business are still weakly developed. Also, the lack of practical skills and innovative thought process, as well as little exposure to international experience during studies (all levels), negatively affects the consequent professional activity.

• Public R&D is not producing sufficient research results relevant to companies or is not working with business on joint innovative projects, due to the lack of applied research.

• There has been an increasing interest in patenting activity at the national level in recent years. Most of the patent applications come from universities and R&D institutes.

• Research facilities are outdated, and research organisations and researchers are not sufficiently connected internationally. There is an issue of low efficiency of research and innovation activities and sporadic implementation of research results.

• There is a lack of TT infrastructure, allocated staff positions, unified documented policy of IP management, and TT/commercialisation activities in PROs. There is no obvious evidence of actual technology transfer resulting in licensing or sale of IP. Only Moldova State University has an internal IP policy to regulate ownership and benefit sharing and this is the only functioning TTO. Spin-offs and start-ups related to research results are not common, and there are
no legislative or policies to regulate this. In general, the researchers are expected to evaluate the commercial potential of their research results and identify IP protection measures without any professional support.

- There is a lack of TT education, expertise in market research, commercial technology evaluation, brokerage and information dissemination on market demand and available funding in private and public sectors.

**Industry**

- Cooperation between science and business is insufficient, together with the practice in conducting joint research.

- There is a lack of multinationals with strong research and development capacity.

- Low receptivity of innovations by the economy is evident, mainly due to the lack of its own financial resources and lack of qualified personnel.

- The activity of innovation and technology transfer is not a priority for the majority of Moldovan companies, highly concentrated on production, with a strong propensity to use classic techniques.

- Business is seen as not being conducted to international standards in terms of legal protections, consistency and transparency, and this leads to a lack of trust in the ecosystem.

**Support organisations**

- There is a deficit of technological intermediaries capable of identifying local business demands for innovations and directing them to the relevant national or international sources.

- Support organisations are mostly concentrated and dominate in the ICT sector and around ICT start-ups.

- Implemented initiatives are more focused on business idea development, and start-up incubation or/and acceleration, than on support with technology transfer activities.

**Funding**

- Very little financing is available for innovation in Moldova. Much of the financing comes from abroad, in terms of foreign direct investment, foreign aid, and remittances. In terms of other forms of capital, especially risk finance, poor perceptions of the domestic investment climate, and issues with specific financial regulations, notably regarding early stage funding to start-ups, hold back investment.

- There is an issue concerning the appropriate finance of the lifecycle of innovation, starting from needs for seed funding, angel investment, VC, equity finance up to crowdfunding. There are some programmes that bring in support but they are limited and not well coordinated or organised. On the other hand, loans from banks are limited by financial regulations and expensive, involving high interests. Research funding is available, but it is limited and the nature of the allocation process drives it into areas of pure research over more applied or commercialised areas.

- The domestic investment climate is a barrier for investors, and bureaucracy leads to significant delays and complications in terms of efforts to invest in the country.
Government

The following general proposals and recommendations are made:

- Carry out the analysis of good international practices of economies with similar backgrounds, selection and adaptation of elements to create a custom R&D&I roadmap suitable for Moldova. This should include establishing the role and functions of each actor within this system, highlighting the links and correlations between them, finding the functional elements and possible gaps and constraints to develop the most appropriate mechanisms for the most effective coordination of the system, based on the goals to be achieved. Improving synergies between the priority areas of innovation activities, spreading innovation beyond science parks and innovation incubators and promoting more market-based clusters and networks will be beneficial and should also be considered.

- Synchronise innovation strategies, policies, and action plans by improving collaboration between different innovation actors, and utilising adequate monitoring and assessment mechanisms.

- Stimulate cooperation between research institutions and the business environment and encourage the commercial exploitation of scientific results, especially by SMEs, by the creation of programmes focused on the innovative development of SMEs and destined mainly for development of the necessary knowledge for entrepreneurs and researchers.

- To become a more prominent R&D partner for domestic and international companies, universities need to pivot towards more applied research, especially in scientific areas that have been identified as having particular strengths for the country, including ICT, chemistry, health and agriculture. This will require a change in the present provision of research funding.

Universities and research organisations

- Education system should be reformed based on a developed strategy that tackles the issue of adequate supply of researchers. Where applicable, evolving industry needs should be reflected in the curricula at all levels of study, together with innovative thinking, IP, technology transfer, and entrepreneurship. This can be achieved through formal and non-formal education.

- Research infrastructure should be updated at PROs to be able to develop innovative technologies and provide adequate services.

- Development of an institutional funding methodology, financial and non-financial programmes such as mobility or R&I grants, internships and mentorships, with the objective of building and maintaining a national research base.

- Technology transfer support should be organised and it should evolve as the PROs develop stronger research and innovation. Accordingly, dedicated technology transfer managers who received the appropriate training should be appointed, the Registered Technology Transfer Professional (RTTP) certification of managers should be facilitated, commercial profiles incorporated, procedures and work methodologies provided to strengthen activities such as the identification of research results, marketing, etc.

- Develop a set of standardised template agreements (non-disclosure agreement (NDA), licence agreement, material transfer agreement (MTA), etc.) which will speed up the process of negotiations and entering into collaborative partnerships or contract research.

- All PROs should be encouraged to adopt an intellectual property policy that incentivises staff and students to
commercially exploit their ideas and research outputs. A template of IP policy may be developed in coordination with AGEPI and WIPO.

- Incentives and resources should be provided to students and researchers, to develop new ideas and cooperate with companies (access to incubator and accelerator programmes, competitions, tools, training, inventor incentivisation, accredited points, etc.).

- Scientific and innovation potential of the PROs should be mapped and publicly listed as a base for collaboration with industry and likewise industry should express its needs to enable PROs to contribute efficiently.

- Mechanisms for identifying the needs of entrepreneurs in scientific research and innovation should be devised and implemented. This could be done in collaboration with the national Chamber of Commerce.

- Develop technology transfer indicators and set up targets to assess the innovation capacity and performance of PROs. Establish a Technology Transfer Advisory Board involving local and foreign experts to evaluate and monitor the system’s performance and provide advice on potential new measures.

- Creation of a national technology transfer network could help in connecting with other international networks as ASTP, transferring international experience to local TTOs, strengthening technology transfer as a profession, strengthening technology transfer position in the Moldovan innovation ecosystem, etc.

**Industry**

- Organising Academic-Industry knowledge exchange days with the objective to match the needs of companies for new knowledge with academic expertise. A good example is the AIM Day developed by Uppsala University in 2008 (https://aimday.se/).

- Reinitiate voucher schemes to support more knowledge transfer with the intention to improve a company’s performance and access to markets and to strengthen its competitive capacity.

- Develop programmes to boost technical assistance in companies as a mechanism for igniting innovation, which can be based on existing knowledge and technological resources of PROs.

- Organise joint raising awareness days covering the importance of innovation, technology transfer, IP, during which the examples of good practices should be presented.

**Funding**

- Create appropriate financing mechanisms and grants schemes at all stages of innovation at national level, covering the whole lifecycle of innovation: PoC (Proof of Concept), pre-seed funding, seed funding, angel investment, VC, equity finance, and establish crowdfunding. This can be done by creation of an Innovation Fund of the Republic of Moldova. A good example of this is the Innovation Fund of the Republic of Serbia.

- Create funding mechanisms and grants schemes at the PRO level (PoC fund, patent fund, TT fund, etc.). This would ensure that a TT unit can be easily recognised by researchers and react quickly in validating and further developing business opportunity. In this way a PRO can increase the TT and innovation activity.

- Create a framework between PROs and foreign BA and VC ready to invest in early stage technologies.

- Enable mechanisms for co-investment funds (public-private) and possible try to attract the private sector and the Diaspora to co-invest.

- Develop incentives to stimulate private sector participation in spin-offs (for example by establishing a mixed fund seeded from the state budget or state institutes of development and private sources).

- Develop financial schemes which could help PROs to create a technology transfer unit and to set up funds which could help them to be supported during the whole cycles of technology transfer (market studies, planning, Freedom to Operate reports, business development, etc.).

- Create incentives for innovative public procurement, joint research units, talent exchange programmes between firms and research centres, industrial PhD studies, etc.

- Strengthen and professionalise angel networks.
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# Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AGEPI</td>
<td>The State Agency for Intellectual Property</td>
</tr>
<tr>
<td>BA</td>
<td>Business Angels</td>
</tr>
<tr>
<td>CIS</td>
<td>Commonwealth of Independent States</td>
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<tr>
<td>CNAA</td>
<td>National Council for Accreditation and Attestation</td>
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<td>EU</td>
<td>European Union</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>ICT</td>
<td>Information and Communication Technologies</td>
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<td>IP</td>
<td>Intellectual Property</td>
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<tr>
<td>MDL</td>
<td>Moldovan Leu</td>
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<tr>
<td>MEI</td>
<td>Ministry of Economy and Infrastructure</td>
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<tr>
<td>MTA</td>
<td>Material transfer agreement</td>
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<tr>
<td>NARD</td>
<td>National Agency for Research and Development</td>
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<tr>
<td>NBS</td>
<td>National Bureau of Statistics</td>
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<tr>
<td>NDA</td>
<td>Non-disclosure agreement</td>
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<tr>
<td>NPRI</td>
<td>National Program for Research and Innovation</td>
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<tr>
<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>OCM</td>
<td>Organisations for Collective Management</td>
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<tr>
<td>PoC</td>
<td>Proof of Concept</td>
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<tr>
<td>PRO</td>
<td>Public Research Organisation</td>
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<tr>
<td>R&amp;D</td>
<td>Research &amp; Development</td>
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<tr>
<td>R&amp;D&amp;I</td>
<td>Research &amp; Development &amp; Innovation</td>
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<tr>
<td>R&amp;I</td>
<td>Research &amp; Innovation</td>
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<tr>
<td>RTTP</td>
<td>Registered Technology Transfer Professional</td>
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<tr>
<td>SME</td>
<td>Small and Medium Sized Enterprise</td>
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<td>STP</td>
<td>Science and Technology Park</td>
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<td>TT</td>
<td>Technology Transfer</td>
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<td>TTO</td>
<td>Technology Transfer Office</td>
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<tr>
<td>TUM</td>
<td>Technical University of Moldova</td>
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<tr>
<td>VC</td>
<td>Venture Capital</td>
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<tr>
<td>WIPO</td>
<td>World Intellectual Property Organization</td>
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The European Commission’s science and knowledge service

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doi:10.2760/553209