Strengthening knowledge triangle in Moldova through innovation

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Several concepts have emerged in recent decades to interpret and illustrate the process of knowledge creation and its application through innovation and these have come from a number of different disciplines. However, they share several core conclusions about the non-linear nature of innovation and the multiple input and feedback loops that exist between the actors in an innovation system. This process is captured by the concept of the knowledge triangle, which suppose close and effective links between education, research and innovation.

Keywords: knowledge, education, research, innovation, business, Moldova.

Introduction

Several concepts have emerged in recent decades to interpret and illustrate the process of knowledge creation and its application through innovation and these have come from a number of different disciplines. However, they share several core conclusions about the non-linear nature of innovation and the multiple input and feedback loops that exist between the actors in an innovation system. For example, a skilled workforce is the basis for undertaking research and development activities, as well as for bringing new products and processes to the market.

In return, knowledge and new market developments should have a feedback loop to educational programmes. Similarly, new knowledge is the source of innovation and in return, new market prospects for innovation can point towards new avenues for research. This process is captured by the concept of the knowledge triangle (fig. 1).

The knowledge triangle concept highlights the positive benefits that can be derived from such strong links. This has led to an acknowledgement that policies in support of innovation should foster systemic interaction between the three forms of activity — education, research and business. The knowledge triangle has also been strongly embedded in the 2020 Vision for the European Research Area [2] and this has increased the importance of its role in European policy-making.

The abstract scheme of the knowledge triangle (KT) reveals the indispensable need and vitality of the interdependence between KT stakeholders for the country's competitive development and knowledge transfer to society and economy. The interaction between KT stakeholders is realized via 3 channels, each of them being double-directional:

1. Relation/interaction between research and higher education. In this relation, the functions of the stakeholders involved in research activities consist in transfer of new knowledge and results of the research process to higher education, development and provision of scientific and methodological knowledge and new methods of its application, etc. Meanwhile, the role of the stakeholders involved in education is to define qualifications for researchers, identify research areas for graduates and coordinate their research projects, etc.
2. Relation/interaction between research and innovation. This relation involves several stakeholders, with distinct functions each.

For example, research and its stakeholders should provide to companies the newest inventions, know-how for using them, as well as provide services of expert examination and feasibility in various fields, etc. In their turn, companies determine and define directions for research, determine the economic parameters for application of research results, and apply the results that promise to be profitable, etc. On the other hand, the institutions promoting technology transfer perform the function of intermediary between research and real economy.

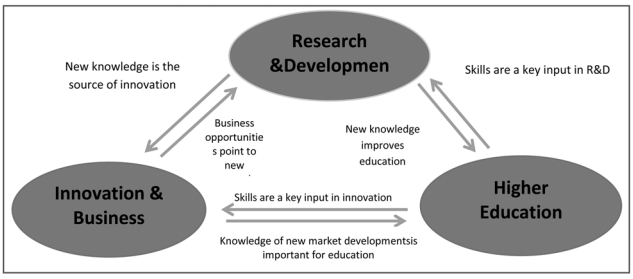

Fig. 1. Theoretical model of the knowledge triangle

Source: Adapted by the author according EIT.Catalysing Innovation in the knowledge triangle. Practices from the EIT Knowledge and Innovation Communities. Available at: [1]

At the same time, organizations that provide support to companies create and ensure the necessary conditions for the development of a healthy business environment and provide legal and economic advice to companies, especially newly created.

3. Relation/interaction between innovation and higher education. In this relation, the private sector (companies) formulate to the academic environment requests for the professional and social competences of future specialists and managers, while universities integrate them into university curricula and prepare professionals and managers according to the modern requirements of the labor market and of real economy. Also, universities contribute to the development of entrepreneurial culture, collaborate with the institutions that promote technology transfer and participate in the communication platform (cluster) between students, scientists and business representatives.

In this context, it is clear that the separate work of each of the KT elements cannot ensure its functionality or, subsequently, benefic effects in the process of establishment of knowledge-based economy at the national level.

Innovation – the main pillar of the knowledge triangle in Republic of Moldova

In Moldova, innovation is regulated by the Law on science and technology parks and innovation incubators no. 138-XVI of 21.06.2007, Law on Informatization and State Information Resources, no. 467-XV of 21.11.2003, Law on the State Agency for Intellectual Property no. 114 of 03 July 2014, Law on Protection of Inventions no. 50-XVI (adopted on 07.03.2008, in force since 04.10.2008), Law on Copyright and Related Rights no. 139 (adopted on 02.07.2010, in force since 01.01.2011) etc. and other legislative acts listed in Table 2 and by strategy papers on research and innovation at national level.

The main institutions responsible for planning, organization and management of innovation in Moldova are the Academy of Science of Republic of Moldova, the Ministry of Economy Agency for Innovation and Technology Transfer (AITT) and the State Agency on Intellectual Property (AGEPI).

As for the innovation funding mechanism in Moldova, it is appropriate to note that the general public budget or the budgets of organizations in Moldova do not include a specific funding line intended for innovation. The National Bureau of Statistics does not calculate an indicator on funding for innovation. It is therefore difficult to estimate the amount of funding for innovation and to assess the balance between funding for research and innovation.

Only the AITT budget is intended for promotion and funding of innovation. However, AITT funding does not exceed 5% of the total funding for R&I from public sources.

It funds innovation through two main instruments:

- technology and innovation projects – the budget is about 6 million lei per year, half of which is used by the private sector;
- science and technology parks and innovation incubators, which form the innovation infrastructure – the budget is approximately equal to 2 million lei per year.

Innovation and technology transfer projects are tools for stimulating innovation in SMEs by partially taking the risks related to innovation.

The technologic transfer represents introduction of technologies and specific plants, of equipment and installations, hybrids, sorts, stems, preparations etc. into economic circuit, resulted of research or purchased, in order to increase the efficiency and quality of certain products, services, processes or obtaining other new, which are demanded on market or by the means of which an innovative behavior is adopted, including the activity of disseminating of information, of explanation, of knowledge rendition, of consultancy, realizing in the transfer of an idea or technology from author to beneficiary.

Technologic transfer of scientific results from the research environment to the business one is the main method of economic growth stimulation, applied in the whole world, and the «Europe-2020» strategy of European Union research in the benefit of SMEs is an absolute priority.

Every year, the Agency for Innovation and Technology Transfer under the Academy of Sciences of Moldova launches a competition of innovation and technology transfer projects with funding from the state budget up to 50% of the total project cost. The mandatory condition for submission of innovation and technology transfer projects is implementation of an innovation or a new technology for Moldova. The innovation and technology transfer implementation period is 2 years at most.

According to the AITT, 33 innovation and technology transfer projects were submitted for the 2014-2015 competition of innovation and technology transfer projects, 12 of which were funded in 2014 from the state budget in the amount of 4,785,700 lei. Also in 2014, 7 ongoing projects for 2013-2014 were funded in the amount

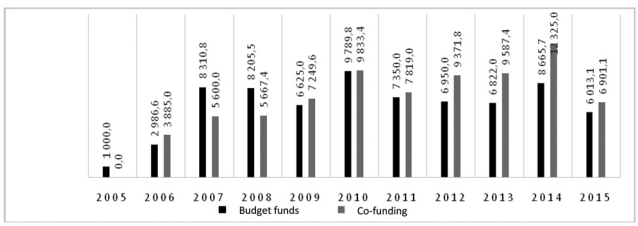

Fig. 2. Dynamics of funding for technology transfer projects in 2005-2015, thousand lei

Source: Adapted by the author according to the data of AITT. Annual report, 2015

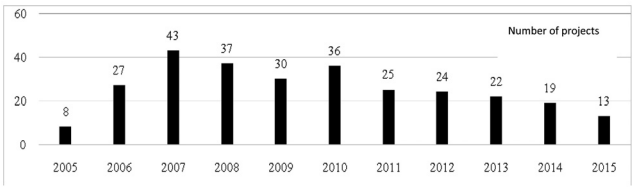

Fig. 3. Dynamics of the number of technology transfer projects for 2005-2015

Source: Adapted by the author according to the data of AITT. Annual report, 2015

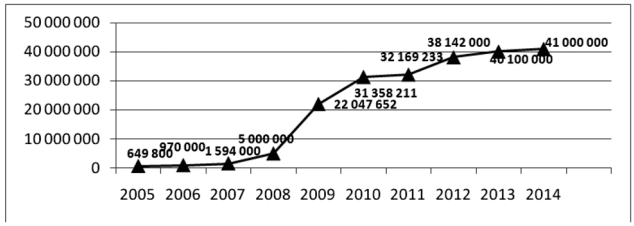

Fig. 4. Amount of innovative products from technology transfer projects marketed in 2005-2014, lei

Source: AITT. Report on managerial activities.2014 (2011-2014). Chisinau 2015

of 3,880,000 lei from the state budget. A total of 19 projects were funded in 2014 in the amount of 8,665,700 lei from the state budget and 11,905,000 lei from private sources, including 11 projects prepared under invention patents, 2 projects for which patent applications will be filed and 6 projects based on know-how [3] (fig. 2 and 3).

The decline in recent years in the number of projects funded is explained by the fact that so far the funds for innovation and technology transfer projects have not been increased. Another reason is the continuously increasing investment costs in projects, which ultimately determine a smaller number of projects funded.

To determine the socio-economic impact of technology transfer projects, it is necessary to assess performance. One of the indicators is the amount of innovation products resulting from these projects. Given the value recorded in 2014, the conclusion is that every leu invested from public and private resources into technology transfer projects yielded 2.0 lei from sales of innovative products (fig. 4).

The current innovation infrastructure of Moldova consists of 3 science and technology parks and 7 innovation incubators, which received funding from public sources. Just like technology transfer projects, these entities, in addition to support from the state budget, come with their own financial contribution. Fig. 5 shows the amount of public funds allocated in 2014 and co-funding of residents.

In 2015, 33 companies held the status of resident in 3 science and technology parks and 7 innovation incubators.In the period of 2011-2015, 8 new entities of the innovation infrastructure were created – 2011: I.I[1] «Universcience» and I.I. «Politehnica»; 2012: I.I. «Inventica-USM», I.I. «Nord», I.I. «Innocenter» and I.I. «Itech»; 2013: I.I. «Antreprenorul Inovativ» 2014: I.I. «Media Garaj»; 2015: I.I. «IT4BA».

In this period, state investment into the development of these entities made up a total of 9,332.5 thousand lei (fig. 6).

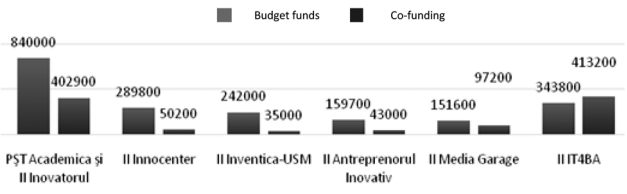

Fig. 5. Structure of funding for innovation infrastructure in Moldova in 2015

Source: AITT. Annual report 2015

Although the number of residents grew in 2013 (due to the creation of the incubator «Antreprenorul Inovativ», which started with 6 residents), other indicators, such as the amount of marketed innovative production and the amount of attracted investments, have been falling. A slight recovery occurred in attracted investments (fig. 7).

Funding for innovation through venture funds, innovation vouchers or other similar instruments able to stimulate innovation in the private sector are not yet well-developed [4].

Also, some innovation activities are funded by the Ministry of Economy, most of them through the Organization for Small and Medium Enterprises Sector Development. The main programs of the which are as follows:

- «PARE 1+1» — a program launched to attract remittances into the economy and mobilize the human and financial resources of migrant workers. The basic principle of this program is that for every invested leu the state offers one more. Thus, the amount of subsidies granted in 2013 through this program was nearly €2 million and migrants' investments about €6 million;
- National Youth Economic Empowerment Program — a program launched to support young entrepreneurs in rural areas and facilitate the creation of start-ups. In 2013, funding through this program amounted at about €5 million;
- Credit Guarantee Fund — an instrument intended to facilitate access to funding for newly created companies, offering them guarantees of 70% of the loan and a warranty period of up to 3 years. By the end of 2013, the amount of investments with the support of this instrument was about €4,5 million.

The analysis of the principles and mechanisms of these funding instruments allows us to emphasize the fact that they also fund (not exclusively) innovation

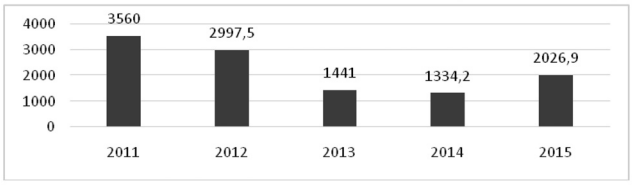

Fig. 6. Dynamics of state investment into the development of innovation infrastructure in 2011-2015, thousand MDL

Source: AITT. Report on managerial activities.2015 (2011-2015). Chisinau 2016

[1] I.I. — Innovation Incubator.

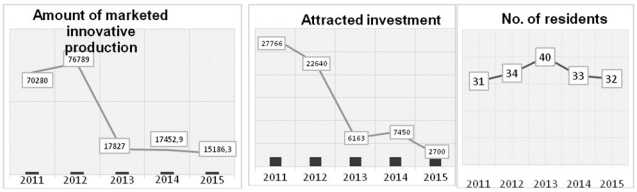

Fig. 7. Dynamics of the main indicators of innovation parks and incubators in the period of 2011-2015, thousands MDL

Source: Elaborated by the author according to the data of AITT. Report on managerial activities, 2015 (2011-2015). Chisinau 2016

activities, but there are no separate accounts monitoring for such activities. Moreover, the budget of these instruments does not meet the requirements of the local business environment. Additionally, the authors consider discriminatory the «PARE 1+1» programme. This opinion is nurtured by the consideration that, according to this program the State offers one MDLfrom the state budget for every MDL from remittances. But, contributors to the state budget are the Moldova citizens who work within the country, and so they, who are usually poorer, must fund those who work or used to work abroad, who are usually richer.

Therefore, the recommendation of the authors to the national authorities is to open the access to this programme to all Moldovan citizens.

National prosperity and high individual living standards, which need to be achieved in a knowledge-based economy, are directly related to the efficient implementation of innovations, which involves using the results of creative activities. In this respect, patenting is an important element of competitiveness and an economic indicator of a country.

Statistics on patents are used as an empirical measure of innovation results. They provide information about the areas of economic interest, about research activities, and can be used for various scientific and economic studies. According to AGEPI, in 2014, 161 applications for various types of intellectual protection were registered and 171 patents were issued, which is 12% more than in 2013. It can be explained by the fact that in 2014 all projects of fundamental and applied scientific research were completed and researchers focused more on the relevance of theoretical and practical scientific results and on their implementation in the country's economy.

The number of patent applications by Moldovan researchers is relatively large compared to population numbers and the size of economy — over 4,500 patent applications in the period of 2006-2012 [5]. However, only 28% had a duration of more than 5 years in 2012. The small number of renewed patents is partly explained by return of taxes for a period of five years, which applies to researchers from Moldova. Other reasons for this situation are low applicability of registered inventions (determined by the profile of the Moldovan economy), weak links between R&D sectors and businesses and, in general, a low innovation culture [4].

The situation regarding invention patents obtained abroad is even more marginal. According to the World Intellectual Property Organization, in the period of 2006-2011 only seven patent applications were filed from Moldova to the European Patent Office, and only nine patent applications to the United States Patent and Trademark Office [5]. It can be explained by the high cost of patenting abroad and by the fact that Moldovan researchers who work in collaboration with foreign partners are rarely listed as the first inventor.

Limited human and financial resources have obvious impact on the quality and performance of the knowledge production. According to the ASM, the List of scientific works published and protection titles obtained by the Moldovan scientific community in 2014 includes 10,395 titles, of which 222 are monographs, 369 are articles published in important journals, etc. However, these results are poorly recognized internationally, which is again suggestive of the poor quality of national scientific research. For Moldova, the Hirsch index (h-index, more and more frequently used as a measure of the value of scientific results published by scientists) is 70, meaning that our scientists, the scientific community, have 70 articles with not less than 70 citations each.

So, only the scientists with works cited at least 70 times in the specialized literature contribute to the Hirsch index for our country. It is indicative of the visibility of local scientists' works and their recognition by the international scientific community of their fields of study. In this respect, the Russian Federation is roughly at India's level but much higher than Romania or Lithuania. Of course, the results reflect the role of scientific schools, or traditions in scientific research. Armenia, for example, reached a Hirsch index of about 120, comparable to that of Lithuania, which is an EU member state.

One reason of our country's poor performance is insufficient funding from the state budget and insignificant contribution of the private sector to the development of science and innovation. The business community is in no hurry to invest substantially in scientific research, and no such investment into research has come from other countries, either. Another problem is that the scientific results obtained by the Moldovan community are published without considering their applicative value. We publish full theses on the website of the National Commission for Accreditation and Attestation, regardless of the field and practical value of the data. At the same time, possible objects of intellectual property that might have commercial interest for the business community, including Western companies, are not considered, either [6].

Another reason is the SMEs'poor innovation capacity,determined by several factors, such as non-awareness about the effects of innovation on company's development, lack of cooperation between businesses and institutions of research and innovation, limited financial resources, etc. Efficient cooperation between universities and businesses provides a decisive prerequisite for economic development and it has attracted great interest in recent years [7].

These reasons are also identified by the World Economic Forum (WEF) as the main barriers to developing an innovation environment in Moldova. According to the Global Competitiveness Index 2014-2015, produced annually by the WEF [8], Moldova is placed 82nd (out of 144 analyzed counties) among the

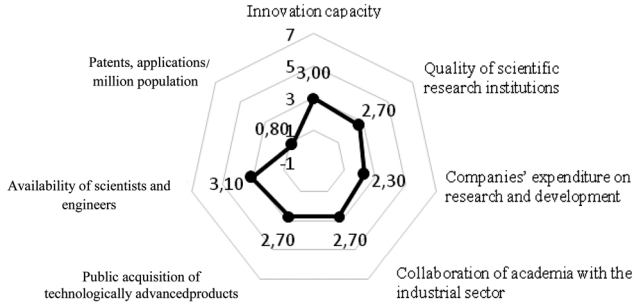

Fig. 8. Innovation performance of Moldova according to the Global Competitiveness Index 2014-2015

Source: Elaborated by author based on the WEF report. Global Competitiveness Report 2014-2015. Available at: http://www.weforum.org/reports/global-competitiveness-report-2014-2015

most competitive economies in the world. For the first time in four years Moldova has improved its score up to 4 points out of 7, after it was 3,9 for three years.

The lowest score, 3.0 points, and therefore the worst position, 131st, Moldova obtained for the «innovation» chapter, and the main reasons are as follows:

- Minimum expenditure of companies on research and development (position 135), because the general context in which local entrepreneurs work forces them to think about how to survive in the market rather than how to develop;
- Lack of scientists and engineers in companies (position 128). Businesses have little interest to implement and apply innovations and high technologies within their companies. Most of them have too narrow a vision on how to do business and give little importance to issues such as investing in human resources or attracting qualified personnel;
- Poor collaboration between businesses and academia (position 124) in a situation when in most countries universities are the main drivers of innovation. However, it should be noted that currently local higher education institutions are not sufficiently adapted to a proper innovation framework, either.

Analysis of the data from the GCI allows us to conclude that the KT in Moldova is still fairly poor, and the major problems in the development of a viable KT are not quite related to the country's innovation capacity or the availability of researchers and engineers, but to the number of invention patent applications, modest participation of companies in funding innovation activities, quality of scientific research institutions, etc. (fig. 8).

Moreover, the synergy potential has been threatened by failures of communication between higher education institutions, the industry sector and other national beneficiaries, as well as by unclear political signals or divergent agendas. In Moldova, the cooperation of universities with businesses has been threatened by numerous barriers. First, the two types of institutions have divergent objectives and priorities (companies seek short-term solutions that universities usually cannot reach; long-term orientation of universities), as well as difficulties in identifying partners. Second, universities are not always interested in the topics proposed by companies, which prefer pragmatic approach over academic.

Third, restriction on the publication of research results and possible conflicts related to intellectual property rights may act as a barrier to the involvement of higher education institutions. We can also mention the lack of mutual trust, lack of governmental support programs that would foster interaction between universities and the business community, lack of marketing related to the R&D&I potential.

Knowledge triangleprovides a test bed for growing collaboration mechanisms amongst innovation actors. Knowledge creation and diffusion is highly localised and entrepreneurship thrives best in areas of concentrated skills and capital, notably in clusters that represent regional groups of interconnected companies and associated institutions in related industrial fields. At the same time, business innovation arises from collaboration in increasingly complex networks.[9] Companies find it harder to achieve results and produce cutting edge innovation in an era of dispersed knowledge and technology [10].

In conclusion it can be said that Moldova needs a smart growth based on a reliable knowledge triangle, built and strengthened by well-thought strategies and policies, with priority directions dedicated to research, development and innovation and to ensuring continuous interaction between these components. As efforts are made to control the public deficit in order to redress public finances and as it appears that the workforce is continually decreasing, Moldova faces various challenges related to the future competitiveness of the country, to generation of new growth and to creation of new jobs, as well as to how the Moldovan economy will be relaunched.

So, Moldova's competitiveness, its capacity to create new jobs to replace those lost due to the crisis and, overall, the future standard of living depends on our country's ability to stimulate innovation in the field of products, services, social and commercial models and processes and to implement information technologies in various activities of the national economy.

So, the only answer is smart growth or economic growth that places the priority accent on education and professional training, research, development, innovation, use of information and communication technologies, investment and competitiveness in all human activities in order to address the major challenges of society today. This smart growth in Republic of Moldova can be achieved through a competitive «knowledge triangle».

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Укрепление треугольника знаний в Молдове посредством инноваций

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В последние десятилетия появились несколько концепций, иллюстрирующих процесс создания и применения знаний за счет инноваций, пришедших из целого ряда других дисциплин. Тем не менее, они свидетельствуют о нелинейном характере природы инноваций и сложном характере взаимосвязей между субъектами инновационной системы. Эти процессы согласуются с концепцией треугольника знаний, которые предполагают тесные и эффективные связи между образованием, исследованиями и инновациями.

Ключевые слова: знания, образование, научные исследования, инновации, бизнес, Молдова.

Российские инновации в медицинской диагностике

21 апреля в пресс-центре МИА «Россия сегодня» прошел очередной отраслевой семинар, посвященный перспективным высокотехнологичным проектам в области медицинского приборостроения в рамках реализации Федеральной целевой программы «Исследования и разработки по приоритетным направлениям развития научно-технологического комплекса России на 2014-2020 годы». В мероприятии приняли участие представители ФАНО, бизнеса, а так же сотрудники ведущих российских вузов и научно-исследовательских центров.

Модератором круглого стола выступил помощник руководителя ФАНО России Геннадий Шепелев. В своем приветственном слове он отметил, что целью данных мероприятий является, прежде всего, привлечение участников в вышеуказанную программу: «Данный семинар мы посвятили, преимущественно, диагностике в медицине. Не смотря на то, что уровень финансирования данной области в нашей стране ниже, чем в странах Евросоюза, мы имеем возможность часть ресурсов, имеющихся в наших традиционных областях, переориентировать в сторону тех направлений, которые касаются жизни каждого человека».

В рамках семинара были представлены уникальные разработки в области медицинской диагностики. Коллектив Российского нового университета в лице заместителя председателя Ученого совета Евгения Палкина, в своем выступлении на тему кардиометрии представил прибор «Кардиокод». Данное устройство успешно показало себя в тестовых исследованиях, имеет широкую область применения, а стандартные методы кардиологии уступают ему в информативности. В планах разработчиков выпускать и модификацию для массового потребления, которая дает возможность в домашних условиях контролировать работу сердечно-сосудистой системы.

По итогам мероприятия были выявлены основные проблемы при коммерциализации инновационной продукции, рассмотрены возможные пути их решения. Участники семинара обменялись опытом реализации поставленных задач.

Ознакомиться с презентационными материалами спикеров, в том числе по представленным инновационным продуктам, можно на сайте http://ano-info.ru.