# OPPORTUNITIES, OBSTACLES AND DEVELOPMENT TRENDS OF RESEARCH COMMERCIALIZATION AND SCIENTIFIC ENTREPRENEURSHIP IN ARMENIA

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Today, one of the most important issues for governments is the development of science. They make policies, strategies towards science development. Universities and scientific institutions have their own strategies aimed at development of science, research and innovation.

One of the main challenges of science development is commercialization issue. The main problems for universities may be connected with lack of financial resources, time constraints, lack of professional scholars, policy/regulation barriers, etc.

Armenia was ranked the 61st in the Global Innovation index 2020, with the score 32.64 in 0-100 scale. Table 1 presents the main pillars of the index for Armenia and for top 5 countries.

Table 1. GII 2020 rankings overall and by pillar[1]

| Country/Economy | Overall GII rank | Score | Human capital & research | Infrastructure | Market sophistication | Business sophistication | Knowledge & technology outputs | Creative outputs |
|---|---|---|---|---|---|---|---|---|
| Switzerland | 1 | 66.08 | 6 | 3 | 6 | 2 | 1 | 2 |
| Sweden | 2 | 62.47 | 3 | 2 | 12 | 1 | 2 | 7 |
| United States of America | 3 | 60.56 | 12 | 24 | 2 | 5 | 3 | 11 |
| United Kingdom | 4 | 59.78 | 10 | 6 | 5 | 19 | 9 | 5 |
| Netherlands | 5 | 58.76 | 14 | 18 | 23 | 4 | 8 | 6 |
| **Armenia** | **61** | **32.64** | **94** | **90** | **68** | **69** | **45** | **56** |

The number of higher educational institutions in Armenia was 55 in 2021[2]. The number of Scientific organizations was 65 in 2020, the number of employees of organizations engaged in scientific researches and developments was 4499, 3657 of which were researchers and technicians. Domestic costs for research and development were 12932.7 million AMD in 2020, 10216.5 million AMD of which was at the expense of budgetary funds.

The volume of scientific and technical works was 12336.6 million AMD, the volume of Research and development works was 11073.0 million AMD, the volume of Scientific-and-technical services was 1263.6 million AMD [3].

However, there is lack of statistical data on the topic of research commercialization in Armenian including data on the researchers' age, scientific fields etc.

[1] https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020.pdf
[2] Statistical Yearbook of Armenia, 2021, https://armstat.am/file/doc/99526838.pdf
[3] Statistical Yearbook of Armenia, 2021, https://armstat.am/file/doc/99526843.pdf

Here we have tried to explore the main opportunities and obstacles of commercialization of scientific research results in Armenia.

**Commercialization of scientific research results at University level in Armenia (examples of some Universities).**

Many universities have departments which deal with commercialization of scholars' scientific products.

**Armenian state University of Economics** has some departments, which deal with commercialization of scientific research results.

1. Amberd Research Center, one of the functions of which is taking steps towards commercializing research results[4].
2. Science department, one of the functions of which is to support the implementation of innovative programs and patenting and commercialization of research results created by the University[5].

One of the main priority areas stated at the ''Science development strategy'' of ASUE for 2020-2024 years is the Commercialization of scientific research[6], towards the implementation of which are responsible the above-mentioned departments.

**National Academy of Sciences** in its websites represents Innovation proposals for 2018 for commercialization. The proposals are divided into two parts. The first part presents the works ready for commercialization. The products obtained as a result of these works are currently produced in the scientific organizations of NAS RA and sold in small amounts. To achieve full commercialization, it is necessary to increase the production and to conquer new markets. The projects included in the second part in varying degrees still require some research work to meet the commercialization conditions to the maximum extent[7].

**International Scientific and Educational Centre of the National Academy of Sciences of the Republic of Armenia** has developed Research strategy 2019- 2023 emphasizing the main priorities, expectations and stages of the vision to have a fully-fledged research educational institution status, (Research University) in the future. The main objectives of the research strategy include also:

- to form a competitive research-innovation potential, contributing to the scientific output of production,
- to enhance international research cooperation,
- to provide a bridge between education, science and research etc.

Expectations include also:

- Integration of competitive research and innovative potential, commercialization of research products, education-research bridge provision.
- A significant increase in the efficiency of applied research, etc[8].

[4] Charter of Amberd Research Center, 2020
[5] Charter of Science department of ASUE, 2021
[6] https://asue.am/upload/files/scientific-board/razmavarakan-cragir.pdf
[7] Innovation Proposals, https://www.sci.am/inno.php?langid=2
[8] Research strategy 2019- 2023, https://www.isec.am/images/razmavarakan_cragir/research-strategy.edited.edited.pdf

In December 2015 the **Armenian National Polytechnic University** launched the implementation of "Technological Innovation Platform" Grant Project within the framework of Competitive Innovation Fund (CIF). Activities of "Technological innovation platform" are

- Productiveness and installation of innovation and research work results of Polytechnopark, organization and coordination of technology transfer,
- Utilization of the innovative portal,
- Utilization of the experiential center, provision of technological and experiential services to other companies on a contract basis,
- Implementation of functions of the technological incubator,
- Conducting the market research,
- Provision of analytical and consultation services,
- Development and implementation of "concept on intellectual property" of the university,
- Management of events aimed at the development of innovative and creative thinking of university employees and learners,
- Management of events aimed at the organization of the processes such as "From idea to the marketplace" at the university,
- Realization of organizational activities and provision of consultation regarding patenting of the inventions,
- Preliminary patent search for the patent application of inventions done by the employees and learners of the university,
- Discovery of market potential for inventions and patents of university employees/learners and market analysis,
- Networking with international patent, innovation and technology transfer organizations and their continual development,
- Implementation of activities aimed at the collaboration "science – entrepreneurship",
- Connections with partners to disseminate scientific results,
- Conducting experiments of proposed new technological solutions,
- Provision of scientific and technological information necessary for the implementation of research projects (studies of information demands for scientific research, analysis and provision of information on scientific and technological activities in Armenia and beyond)[9].

In July 2019 **Brusov State University (BSU)** has started implementing a grant project titled "Establishment of HayLingvoTech Center for Excellence in Language and Educational Technologies'' founded the Competitive Innovation Fund[10] (CIF) implemented within the World Bank funded "Education Improvement Project" and intends to apply part of the proceeds for consulting services.

The main goal of the project is to develop technology-based education and research in the fields of Applied Linguistics and Educational Sciences in Armenia by training multidisciplinary specialists from interdisciplinary specializations combining Linguistics, Computer Science and Mathematics, Educational and Computer Science,

[9] Technological Innovation Platform, https://polytech.am/en/centers/center-for-scientific-research-and-innovations/
[10] Competitive Innovation Fund for Higher Education Institutions, https://brusov.am/en/page_list/_haylingvotech_/#sthash.cLufjMdo.dpuf

Translation and Technology. The specific goals of the project are also to involve learners in the research-innovative works of "HayLingvoTech", to promote the commercialization of their results[11].

**Foundation for Armenian Science and Technology**

In November 2020, FAST designed the SciNova Program aimed at creating a curriculum on "Research Design" and "Science Commercialization''. The curriculum introduces Masters and/or Ph.D. students in Armenia to the basics of conducting quality research and creating commercial value from scientific inventions.

In the first half of 2021, the curriculum was developed by FAST and piloted at the Armenian National Agrarian University (ANAU). In addition, training of trainers (ToTs) for a broader audience of academic staff was organized with the participation of key Armenian higher education institutions (HEIs) that provide STEM education.

The scale-up of the program anticipates integration of the developed curriculum into the academic programs of the main Armenian HEIs starting from the 2022-2023 academic year and beyond.

For this purpose, Training of Trainers will be made available to the academic staff from all institutions, as well as a bilingual manual will be developed and provided for free to ensure the smooth integration of the program.

This program is implemented jointly with Aston University within the Creative Spark: Higher Education Enterprise Programme framework funded by the British Council.

In order to support academic staff in successfully delivering the curriculum, a training of trainers has been conducted for 39 academic staff from Armenian National Agrarian University, Yerevan State University of Economics, Yerevan State University, Yerevan State Medical University, and International Scientific - Educational Center of NAS RA[12].

*Although universities have strategies, departments which deal with commercialization issues, however, the main obstacles are connected with lack of financial resources, lack of professional scientists, technical problems, etc.*

**State policy and legislative regulations aimed at promoting knowledge-based entrepreneurship and commercialization of research results in Armenia**

In the document about ''Armenia development strategy for 2014-2015'', there is a section about science[13]. Here are some important parts from the strategy.

- ✓ According to data provided by the Ministry of Education and Science, today around 80% of public allocations to the science are targeted at fundamental studies and only 20% at developments of applied nature. Whereas in US 16% of the funds are earmarked for fundamental studies, 26-28% for applied studies and 56-58% is spent on experimental and engineering works and technological developments.

[11] https://www.cfep.am/en/announcements/item/2021/05/19/4032/, https://escs.am/am/news/7956?fbclid=IwAR2wNa1yCdIqh6HPSL1pQzJfuCS0K2Gmt2v0iYZuWOiI09IOH4WasXe_xpQ

[12] https://fast.foundation/en/program/2097

[13] https://policy.asiapacificenergy.org/sites/default/files/Development%20Strategy%20of%20the%20Republic%20of%20Armenia%20for%202014-2025_ENG.pdf

- ✓ In addition to the financial problem, among factors hampering development of knowledge- based economy is the lack of relevant environment favouring acquisition and dissemination of know-how, application of outdated technologies in a number of branches of industry, absence of stimulus to be involved in research and absence demand for high scientific qualification, as well as existence of economic monopolies.
- ✓ Another key problem is about the human resources in science. After the collapse of the Soviet Union the country faced an overall aging of academic staff and in some areas elimination of the entire academic school. The absence of a targeted policy promoting effective reproduction of the country's scientific potential leads to insufficient turnover of generations of scientific and academic resources. There is significant drain of young specialists from science, which can create serious difficulties for development of science. To ensure effective changing of generations in science, the State Committee of Science of the Ministry of Education and Science has developed a program to attract young people in the sphere of science by aiming creation of relevant employment and socioeconomic conditions in order to use effectively the creative potential of young specialists, as well as to implement activities aimed at increasing attractiveness of science.
- ✓ Lastly, the nowadays scientific and technical logistical basis and infrastructures limit opportunities to conduct researches meeting contemporary requirements and standards and do not contribute to effective utilization of available academic potential. Absolute majority of equipment is obsolete, which does not enable high-quality research activities, particularly of applied nature.
- ✓ In some cases the created applied scientific products are not competitive in the global innovations' market. This stems from objective and subjective reasons. The fact of not having developed infrastructures for academic studies leads to decline of competitiveness of applied scientific products.
- ✓ Existing gaps between the science and industry should be bridged and restored. Innovations and achievement of new development levels should be the primary goal of any industrial enterprise activity. In this regard an important aspect is registration of new trademarks, new products, as well as granting patents for scientific discoveries, as well as implementation of their commercialization policy.
- ✓ Creation of favorable economic environment and expansion of business opportunities is critical for scientific organizations.
- ✓ Commercialization of science requires state support in implementation of applied studies. Addressing this type of scientific and technical issues should dwell on public-private cooperation mechanism by implementing co-funding programs jointly with the private sector. Such co-funding programs are already being implemented with 15% share of private sector in 2011 and 25% in 2013. In the future state budget allocations should be expanded and the share of off-budget resources should reach 50%. Besides, there is a need of public targeted programs geared at addressing specific problems of an economic sphere. These programs should be developed jointly by the responsible public agency and research institution responsible for scientific research and development of the concerned direction.
- ✓ Implementation of an effective innovation system is critical for development of knowledge- based economy in the country. Research and developments require involvement of venture capital, creation of scientific and

industrial centers, as well as establishment of business incubators and techno parks at universities.

- ✓ Organization of modern industries in Armenia is important, as it will improve competitiveness of created academic products. Another important aspect is development of centers for commercialization of academic products. These centers should be specialized in two directions: (i) clearly define what producers' needs are (ii) present the standards/criteria to the academicians. At the end they should perform as mediators and ensure commercialization of the created products.
- ✓ Innovative activities of SMEs should be encouraged actively. Importance is attached to diversification policy of locomotive and priority branches of industry (clusters), i.e. establishing clusters on the scientific platform with good academic potential, thus boosting development of the branch. On the other hand, industrial activities of SMEs should be promoted, since trade in Armenia's GDP has reached 12%, which proves largely commercial nature of SMEs.
- ✓ Coordinated reforms in the sphere of management of intellectual property will be targeted at protecting products of intellectual activities and ensuring their marketing in Armenia and other countries. Among priority objectives are improvement of the legislative framework, training and education of national human resources, regular study of innovative activities according to economy branches, creation of a computerized information system on intellectual property and development of adequate infrastructures.
- ✓ Tax policy should become one of the pillars preserving the country's intellectual and educational potential. Tax incentives should serve as an effective mean of maintaining and strengthening the country's intellectual potential[14].

By the ''Law of the Republic of Armenia on state support to innovation activities'', state support to innovation policy is implemented by yearly program, which includes events in the following directions:

a) Creation and development of innovation infrastructures;

b) Implementation of innovation projects;

c) Staff training and retraining;

d) Consulting.

e) Technology transfer and commercialization;

f) Introduction of international standards[15].

In 2009 the government of the RA had a decision on approval of ''Armenian scientists' potential consolidation program''. One of the main issues of that program is involvement of Armenian scientists from foreign countries in the independent expert system of scientific programs in the Republic of Armenia, in international scientific-

[14] https://policy.asiapacificenergy.org/sites/default/files/Development%20Strategy%20of%20the%20Republic%20of%20Armenia%20for%202014-2025_ENG.pdf

[15] http://scs.am/files/HO-63-n-14.06.2006-inovacia.pdf

educational programs, in the commercialization of the results of scientific activities, in the training of science managers and in the introduction of modern management in scientific organizations[16].

**About the legislation on Technologies commercialization (transfer) in Armenia[17]**

''National center for innovation and entrepreneurship'' state non-commercial organization was established in 2009[18] by the decision of the Government of the RA, the main goals of which are:

1. Developing and investing effective technology transfer mechanisms;
2. Provision of scientific-technical information and library services.

The subject of the organization's activity is:

- Support for the commercialization of intellectual property.
- Establishment, analysis, publication of unified databases of innovation research.
- Cooperation with foreign and relevant international innovation infrastructures.
- Identification of projects with innovative attractiveness, as well as the provision of market promotion services.
- Regular collection, development, storage of relevant scientific and technical resources through the introduction of modern information systems, through the scientific and technical library operating in the administrative structure of the organization.

The Government of the Republic of Armenia, by emphasizing the development of a knowledge-based economy, the strengthening of science-economy relations, as well as the application of scientific innovations and technologies in the economy, aims to introduce support mechanisms for promotion of innovation and knowledge-based entrepreneurship. It is planned to establish a ''Technology Commercialization (Transfer) Office'' within the "National Center for Innovation and Entrepreneurship" SNCO of the Ministry of Economy of the RA and to implement the Technology Commercialization Program (hereinafter referred to as the program).

At the same time, it should be noted that the implementation of the program is based on the vision of creating a knowledge-based economy in the Republic of Armenia, on the program of the Government of the Republic of Armenia for 2021-2026[19], and on the program of "Approval of the Concept of 4. 1 Innovative Initiatives, Development and Implementation of Programs after Approval" of the SME program envisaged by Annex 1[20] of the RA Government Decision N 1902-L of November 18, 2021. In this regard, the process of reorganization and improvement of the organization has been initiated, as it is planned to create a "Technology transfer office" (Technology transfer), which will deal with the commercialization of inventions and technologies, will contribute to the realization of knowledge-based economy.

**The implementation of the program will provide:**

1) Commercialization of inventions, technologies and services of research groups operating in the Republic of Armenia into products and services that will improve the quality of life of people, both in the Republic of Armenia

[16] https://www.arlis.am/DocumentView.aspx?DocID=51373
[17] The information below was provided by the ''National center for innovation and entrepreneurship'' state non-commercial organization
[18] https://www.arlis.am/DocumentView.aspx?docid=67573
[19] https://www.gov.am/files/docs/4586.pdf
[20] https://www.gov.am/files/docs/4685.pdf

and abroad. It will ensure the creation of new jobs and innovation organizations, making Armenia more competitive in the international market.

2) Signing license agreements, as a result of which the technologies will be transferred to the producers, and the research centres will receive money from it, and will further receive from their commercialization;

3) Additional financing of scientific institutions through the implementation of joint applied research programs;

4) Introducing a culture of intellectual property protection;

5) Establishment of new research companies.

Besides, through the establishment of a multifunctional center, it will contribute to the establishment and development of the business ecosystem in the Republic of Armenia, including the development of small and medium enterprises, will provide comprehensive services, consulting, business services, and support.

It will help to the equipping of 1 center in each region. The center will have business consulting services, technology transfer offices, business incubation programs, trainings will be organized there, and there will be comfortable office rental conditions for start-ups or small companies. The branches of the center will contribute to the creation of new non-agricultural jobs in the regions.

Annually after equipping each "National Center for Innovation and Entrepreneurship" office:

- 500 entrepreneurs (with emphasis on women and regional population) will become beneficiaries of SME incubation program,
- Support for 500 SMEs, of which SME support for developing at least 20 scientific products;
- 150 trainings,
- Registration of 10 new resident companies,
- Commercialization or localization of up to 10 inventions.