Extended Abstract

Development of Scientific and Innovation Policy in Armenia since 2000s

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Introduction. The paper deals with an overview of developments in S&T and innovation sectors in Armenia during the last decade, describes its current state, policy documents adopted during last years directed to promote innovation and develop national innovation system, and analyzes the government actions towards addressing the pressing challenge of reformation of S&T and innovation system in accordance with the requirements of the market economy and needs of economic development of the country. It also derives the policy implications that, to my mind, might have positive effect on the efforts of the country towards building knowledge-based economy.

General Overview of S&T and Innovation System Development. During the socialist period S&T in the USSR enjoyed a significant state support. Continuous attempts to accelerate S&T progress or to introduce new military and civilian technologies required that the R&D system, especially in defense sector, be sustained on a large scale.

Armenia was a part of that huge S&T system, having been developed into one of the leading scientific centers of the country starting from mid 1950s. By the end of 1980s Armenia possessed a ramified and actively operating system of research and technological institutions. These capabilities were oriented to a significant degree toward supporting the Soviet military-industrial complex and most of research institutions were well financed directly from Moscow.

Collapse of the Soviet Union in early 1990s has led to disintegration of all previous ties, suspension of huge financial flows to S&T sector, and radical change in factors determining R&D supply and
demand sides. Actually, the demand side nearly fully disappeared in Armenia at once, following emergence of political, economic and social problems in entire territory of the former USSR, bursting out of ethnic conflicts in the region, and persisting blockade of transportation routes.

Nowadays a pressing challenge for Armenia is the reformation of its S&T and innovation system in accordance with the requirements of market economy. It is obvious that S&T can play a decisive role in assuring sustainable economic growth in our transition country where significant RTD potential existed. Meanwhile, in Armenia no major reformation has been implemented in the field of S&T and innovation management system both on national and institutional levels since the collapse of the SU, which is one of the core reasons for inadequate innovation performance in the country.

Science, technology and innovation (STI) policy was underestimated in overall economic policy and was neglected in Armenia during first decade of transition. This might be reasoned by the absence of long-term economic development strategy where STI policy could be incorporated as integral part.

The economic growth in developed countries is basically provided thanks to the creation and usage of new knowledge and technologies. That’s why the research and S&T activities in such countries deserve the unprecedented support of the state. The necessity of the coordination of S&T activities by the state is connected with the scientific “production” and peculiarities of the products. The cause is mostly the unpredictability of economic results of scientific research, when it is very difficult to wait for a profit even from the results with commercial prospective, in the existing conditions of IP protection system. But market is not able to provide the necessary investments in science. That’s why it is necessary for the state to coordinate the scientific sphere. Because of this, the main problem of state S&T and innovation policy must be the development and implementation of necessary steps for lessening the risks and other factors impeding innovation activities.

On the path to the development of innovation process there are a number of difficulties. For the successful implementation of innovation it is too little just to have a good or even a genius idea. It is necessary to embody this idea practically into a concrete production, to bring it to the consumers to
prove its advantages in comparison with the existing analogues, to save it from the possible competitors and use of imitators. Thus the innovation process demands significant resources of organizational and personnel essence.

The process of innovation implementation can be represented in the form of linear chain of certain phases. One of the possible variants of so called innovation chain or innovation management is represented in Figure 1.

Thus S&T innovation process starts from the generation of a new prospective idea (it can be either a completely original new idea or a famous idea saturated with new economic contents) and finishes with a ready product invested in the market. In the second phase, the testing of technical practicability of the idea and the analyzes of possible demands of the market are being done. This is one of the most important phases of the innovation process as the further destiny of the idea mostly depends on it. It is
just in this phase that a big part of potential innovations are being failed. If the idea successfully passes through the testing phase, than it comes the phase of creating experimental example of the product or technological equipment. In many cases, here it becomes necessary to do additional applied R&D.

The third phase is closely linked with the fourth phase, during which complex testing of the experimental example or of the new technology and the basic technical characteristics are being improved. In other words, necessary conditions are being formed for commercial success in the market. In order to be sure in the correctness of the estimates made in the earlier phases, to avoid unexpected difficulties and to improve the innovation-product taking into account the demands of consumers, it is suggested to test the market with the small part of the new product. If this testing passes successfully as well, then starts the preparation to the broad scale forwarding to the market. It is being done within two basic directions: first, by the way of creating corresponding capacities for extending the volumes of production or services, and second, by the way of strong advertising of the innovation and by the formation of a sales base involving other commercial structures.

Though, it must be mentioned that the scheme depicted in the figure 1 is shortened as it almost doesn’t take into account the strong influence of the backward links in the all phases of the innovation process. Innovation process worth to be considered like processes penetrating all science technical productive marketing, entrepreneurial activities at last oriented to satisfy concrete public demands.

The problem in the case of Armenia is that this chain doesn’t function accordingly. No special procedures concerning project evaluations and impact assessment exist to evaluate the quality of innovations, especially in the second phase of the chain. So there is a deep gap between the demand and supply as basically they don’t correspond to each other.

**Innovation Performance: Trends and Objectives.** International benchmarking shows that sustainable economic growth can only be founded on technological development and the continuous increase in the knowledge base, in which the Government support is necessary.
In 2003 UNESCO organized a special parliamentary Round Table to tackle the issues of STI development. The key message coming from the seminar was to encourage parliaments to take a proactive role in developing science, technology and innovation policy for increasing the quality of life and human welfare. There are a number of key analytical lessons that can be learned from the national parliamentary experiences. These lessons can be sources of reflection and inspiration for such countries and regions of the world like Armenia. The Round Table engaged in in-depth discussions about the major fundamental factors impacting national and global STI policies.

![Role of Parliaments in National Innovation Policy](image)

**Figure 2. Role of Parliaments in NIP**

It’s known, that the main lever supporting R&D in country is the state budget. In developed countries the state supplies from the one fifth up to one half of the national science budget expenses, and in fundamental sciences from one half to two third. In such a country like Armenia without a hesitation can be said that that number is much bigger. Fundamental research in the academy of sciences, state scientific centers and universities is fully financed by the state budget. Defense oriented research both in state and private sector, as well as the works of creating much expensive and large research stations also get financing from the state budget.

In the industrially developed countries the volumes of science financing in the part of budget expenses in the last decades were sustainable high. In USA it makes 6-7%, in France, German, Great Britain,
Italy 4-5%, in Japan 3-3.5%. Though, in Armenia the volumes of science financing factually make only about 1% of expenditure part of the state budget. Budget financing of universities and state research organizations is being implemented via grants allocated to research projects. The grants are considered as one of the most productive ways of fundamental science financing.

The next important lever after the state budget, which is used in developed countries for the execution of state S&T policy, has an organizational essence. The use of the mechanisms of organizational essence allows providing cooperation (in the circles of legislation) between the state and private sectors involved in S&T sphere, which is so much lacking in the case of Armenia. In these conditions, the flows of financial means from the state budget to joint corporative structures, must be provided by a number of organizational mechanisms, which must be developed and implemented by the joint efforts of legislative and executive hands of authorities, and with the participation of corresponding ministries, departments and interested organizations.

In Armenia the idea of government order in the sphere of science is formed recently in the form of state goal-oriented programs and basically has got another essence as it also serves mostly for the state scientific organizations. So, in Armenia the research is being developed and implemented through three main financing mechanisms: basic financing, thematic (project based) financing and goal-oriented project financing.

Starting from the early 2000s an array of policy documents were adopted in Armenia towards the regulation of S&T and innovation policy in the country. In December 2000, the Armenian Parliament adopted the Law on Scientific and Technological Activity aiming at regulating interrelations between R&D performers, state bodies, and R&D outcome consumers, as well as outlining general principles of formation and implementation of state policy in the field of S&T.

In 2005 Government took the decision to approve an Action Plan 2005-2010 directed towards the creation and development of the innovation system in Armenia which was defining around 20 measures to be implemented in the period of 2005-2010.
In May 2006, the Law on the State Support to Innovation Activity was adopted (which was the first measure of the mentioned action plan 2005-2010), which defined the legal and economic bases of national innovation policy formation and implementation, and forms of state support to innovation activity.

To improve policy-making and better coordination in the field of S&T, the government took the decision in October 2007 to create State Committee of Science and empower it to carry out integrated S&T policy in the country. This structure is responsible for development and implementation of research programs in the country.

Among the number of adopted policy documents supporting S&T and Innovation system are the Concept on Development of Science in Armenia, which identified S&T development as a priority task for the state, the Resolution on Science and Technology Development Priorities in the country, the Resolution on Science and Technology Development Priorities in the country, incorporating 8 areas, including information technologies, advanced technologies (biotechnology, nanotechnology), etc., the Concept of Innovation Activity in the Republic of Armenia, aiming at formulation of general approaches and principles of the state policy directed towards consistent creation and development of a national innovation system, and its basic elements and infrastructure, capable of ensuring sustainable development of the country and increasing its competitiveness, and creating a favorable innovation environment for international economic co-operation, 2011-2015 Strategy of the Development of Scientific Sphere, adopted in the beginning of 2010, etc.

In July 2007 The Armenian Government adopted “Conception on Improvements in Science Sector in the Republic of Armenia”, which set several clear targets for action. The primary objective of improvements is the creation of knowledge-based economy and in this process strong state leadership is needed. Primary steps defined in more detail in the decision are as follows:

- establishment of a united state science governing body,
• increase in science funding, clarification of funding forms and mechanisms, enhancing productivity of funding,
• enhancing effectiveness of activity in scientific organizations,
• maintenance of focused and effective reproduction of scientific potential,
• modernization and creation of new infrastructures, material and technical base,
• introduction of independent scientific expertise system,
• definition of science development priorities,
• integration of science and education,
• fostering commercialization of scientific results and exporting to foreign market.

Thus, these measures of the Armenian government can be considered as initial steps towards the development of a legislative framework and improvement of the information support and institutional basis of the innovation system. The issues of effective management of innovative resources, modernization of S&T basis, introduction of incentives for innovative companies, and attraction of private investments need to be still addressed adequately.

But all these conceptual and legislative measures need to be supported by adequate concrete actions and programmes directed towards forming the national innovation system. At the moment they have more of a declarative and fragmented character and are not supported by adequate financial commitments and tailor-made decisive actions consistent with general economic development trends.

The Action Plan measures have been implemented very slowly with considerable delay in timetable, and in 2006 only a small amount of funding (around 40,000 Euro) was allocated from the state budget for implementation of the planned activities, particularly, for the creation of Information and Analytical Centre and Permanent Exhibition of Innovative Projects at the Armenian Centre of S&T Information, and creation of the Research and Innovation Centre of Advanced Technologies and Integrated Information Network of Innovation Infrastructure at Yerevan Physics Institute.
In absolute values the budgetary expenditure on R&D has increased in Armenia during recent years. The annual rate of growth in 2006 compared with the previous year was 18.7%, and in 2007 it was 20% compared to 2006 (in real terms), in 2011 it is 8.8% compared to 2010.

In general, program development, project coordination and outcome application mechanisms still need to be improved and adequately implemented according to the adopted policy documents. In Armenia, no indirect measures have been implemented to stimulate innovation in the business sector, for instance, in the form of tax and customs benefits or exemptions. Existing regulations do not stimulate the creation of spin-off companies at academic institutes and universities. There is a need also to address intellectual property ownership issues, especially intellectual property created as a result of government financing.

The aforementioned arguments are tried to be generalized in a SWOT overview of innovation governance in Armenia, which is illustrated in Figure 2.

<table>
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<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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<tr>
<td>• High economic growth rates (13.8% in 2007) registered during last decade create favorable conditions for stimulation of innovation activities</td>
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<td>• Adoption of several legal and strategic documents towards creation and development of innovation system</td>
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<td>• Creation of authorized body responsible for S&amp;T policy-making and development (State Committee of Science)</td>
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<td>• Developed scientific system with advanced scientists and scientific organizations and institutes</td>
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<td>• Existence of R&amp;D big potential</td>
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<td>• Inadequate enforcement of adopted policy documents</td>
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<td>• Lack of the quantitative targets in the most of adopted policy documents directed to promotion of innovation</td>
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<td>• Poor development of innovation support infrastructure</td>
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<td>• Not enough level of R&amp;D expenditure and negligible degree of share of private sector in it</td>
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<td>• Lack of the mechanisms of economic support: lack of incentives for stimulation and growth of innovative and science-intensive organizations</td>
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<td>• Lack of the policy of supporting to the innovation start-up companies</td>
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<td>• The Scientific institutes are technically old</td>
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<td>• The age of scientists is quite higher from the middle</td>
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<td>• Lack of modernization in processes and technologies</td>
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<td>Opportunities</td>
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<td>------------------------------------------------------------------------------</td>
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<td>• Growing ICT sector as possible engine and a good example of innovative</td>
<td>• Adopted innovation policy documents are not based on strategic economic development priorities of the country</td>
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<td>activity in other sectors of Economy</td>
<td>• R&amp;D system and infrastructure remain nearly unchanged and far away from real economic and social needs of the country</td>
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<td>• Strong Diaspora ready to bring new knowledge and investments in case of</td>
<td>• Young scientists with high qualification leave for other, basically more developed (mostly EU countries and USA) countries</td>
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<td>favorable conditions</td>
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<td>• Young specialists with high education, good skills and knowledge of different languages</td>
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Figure 3. SWOT overview of innovation in Armenia

Thus taking into account all the above mentioned issues that obstacle to the development of STI policy in the country, the following recommendations would be useful for the Armenian case:

• Science needs to be integrated into technology and industry policies.

• National Innovation System needs to be based on Lifelong Learning

• Need for the National Information Society Program and the effective utilization of ICT, and later on, based on the outcomes of that, a National Knowledge Society Strategy.

• To organize international benchmarking, evaluation and assessment. To attract desired partners for international cooperation and substantial evaluation

• Increase the funding of the Armenian national science.

• Enable the existing top-level research to be upgraded to international cooperation

• Science institutes to be integrated into universities - creating the way to an integrated policy towards the system of Centers of Excellence, a research institution network altering the practices of the entire university system. A large amount of dispersed institutions built on too weak foundation of operations must be reorganized one way or the other to redirect their activities towards solid growth.

• National STI priorities to be defined and implemented

• To increasing investments in R&D aiming more at the development of knowledge-intensive services.
To create innovation management and innovation leadership specialists.

To create new incentives for entrepreneurship, including special training programs, tax incentives and organizing action for venture capital funds

To create special business-oriented study programs which are linked to service science and product development and thus increasing the attractiveness of business-focused scientists

Technopark development needs to be strengthened - creating a national science and innovation park in Yerevan

From international cooperation to in-depth collaboration; effective use of existing opportunities (an extensive global Diaspora)

**Conclusion.** Thus, basing on the experience of economically developed countries, it can be concluded that living scientific systems alongside with their potential profitability, can be formed and survive only in the conditions of state support and right S&T policy. It involves the existence of officially formed realistic priorities, the volumes of state budget financing, and the investment of corresponding structural-legal forms in the sphere of science and the creation of favorable legislative field. Summing up the trends and problems in the creation and development of the national innovation system in Armenia, it should be mentioned that one of the main goals of the state is to create a favorable and sustainable overall environment for innovation and investment in R&D-intensive activities. The government has had various initiatives to create a favourable legal environment for innovation and create the necessary constituents of a national innovation system, but the problem is that many adopted legal documents and measures are not adequately enforced. Most of the adopted strategic policy documents lack concrete quantitative targets - to be addressed within a certain time frame - and are not based on objective analysis of the current situation and weaknesses of the system. In general, the role of government is crucial in ensuring adequate S&T and innovation policy as an integrated part of overall economic policy and long-term development strategy of the country.
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