

FEATURES OF INNOVATIVE DEVELOPMENT AND TRANSFER OF TECHNOLOGIES IN SCO MEMBER COUNTRIES

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***Abstract:** In article forms and conditions of interaction of participants of innovative process, feature of creation and development of innovative systems and transfer of technologies in member countries of the Shanghai Cooperation Organization (SCO) are considered. On the basis of the analysis of the innovative systems functioning in various countries (Kazakhstan, Russia, China, Kyrgyzstan, Uzbekistan, Tajikistan), the author allocates the key and most perspective directions of development of integration of scientific and educational, production spheres and the state for the purpose of special mechanisms formation of the innovative processes organization for providing effective interaction between all its participants. The conclusion about need of creation of the organizational system based on integration of institutes of the state, science, business and education in SCO countries for formation of competitive hi-tech production, improvement of structure of export due to increase in a share of innovative production in them and decrease in a raw orientation, increase of the status of the countries in the world market of technologies is drawn.*

***Keywords:** transfer of technologies, innovations, innovative process, hi-tech production, market of technologies, integration, Shanghai Cooperation Organization (SCO).*

***JEL codes:** O32, O5.*

1. Introduction

Development and economic growth of almost any country depends on a number of factors, ensuring both increase of real production volumes, and improvement of growth quality, as well as effectiveness level. In course of development of economies this range of factors and estimated cost of the factors value change. But development of innovative industry, high-tech, and knowledge economy shift to the first place for most of leading countries of the world. In modern conditions the level of development of innovative economy creates world economic

superiority of the country. The innovative economy becomes the following economic formation replacing industrial economy.

The major place in the world market of high technologies is taken by the economic organizations and the unions. So, member countries of SCO not only carry out interaction in social and economic, scientific and technological, other spheres, but also have a significant amount of resources, important for world economy:

- Kazakhstan is the 2nd economy of the former Soviet Union (after Russia), the largest in Central Asia, possesses huge reserves of fossil fuel, and large supplies of other minerals and metals;

- Russia is the 5-6th economy of the world at par GDP, it is rich with mineral resources, one of two world's largest nuclear powers has the world's largest territory;

- China is the 1st economy of the world at par GDP and the world's 1st exporter, the owner of the world's largest currency reserves, the most multiinhabited country, has the nuclear power;

- Kyrgyzstan - is on crossing of two major transport axes conducting with the North on the South and with the West on the East, has the considerable potential for development of transport infrastructure;

- Uzbekistan takes the 11th place in the world on natural gas production, the third place in the world on export and the sixth place on production of cotton, the seventh place in the world on uranium reserves (4% of world reserves of uranium), on the general reserves of gold Uzbekistan stands on the fourth place in the world, and on level of production of gold — on the ninth;

- Tajikistan is rich with minerals. So, in its territory the world largest field of silver (Big Konomansur) is located, there are considerable fields of gemstones, uranium (up to 16% of world reserves), gold, coal, aluminum and polymetallic ores.

2. Methodology and Data

As basic research methods we used system approach, comparative and statistical analysis of indicative values of innovation and technological development of the SCO member countries. So, system approach found reflection in application of all elements of innovative process (the states, spheres of science, the industry, etc.) that allows to reveal prerequisites of technological development of the SCO economy. Investigating problems of technological transfer in the countries of the SCO, the author analyzes both statistical data, and the legislative base which is

the cornerstone of formation of national innovative systems of member countries of SCO. Methods of the comparative and statistical analysis of data are for this purpose applied.

So, since 2007 the Intelligence Unit of the Economist magazine calculates The Global Innovation Index annually (GII) showing innovative development of the countries which are at the different levels of economic development including assessment of their potential (see Table 1). Thus, in 2018 the research included 126 countries, which constitute 99.4% of the global GDP. The rating for a row of years is headed by Switzerland. Russia, occupying the 62nd place in 2013, reached the 46rd place in 2018.

Tab. 1. The Global Innovation Index (SCO member countries), 2018

Country / Economy	Score (0-100)	Rank	Income	Rank	Region	Rank	Efficiency Ratio	Rank
China	53.06	17	UM	1	SEAO	5	0.92	3
Russian Federation	37.90	46	UM	6	EUR	31	0.58	77
Kazakhstan	31.42	74	UM	19	CSA	3	0.44	111
Kyrgyzstan	27.56	94	LM	15	CSA	5	0.45	106
Tajikistan	26.51	101	LM	18	CSA	6	0.60	67
Uzbekistan*	25.89	122	LM	27	CSA	8	0.53	123

Note: World Bank Income Group Classification: LI - low income; LM - lower-middle income; UM - upper-middle income; HI - high income. Regions are based on the United Nations Classification: EUR - Europe; NAC - Northern America; LCN - Latin America and Caribbean; CSA - Central and Southern Asia; NAWA - Northern Africa and Western Asia; SEAO - South East Asia, East Asia and Oceania

*Data on Uzbekistan are given according by The Global Innovation Index (2015). In 2016-2018 Uzbekistan was not included in GII.

Source: Compiled by the author based on data provided by The Global Innovation Index, 2018.

3. Results and Discussion

Economic and technological development of the SCO member countries means forming a regional model of development, which includes intraregional distribution of labor in accordance with geographic location, natural resources, level of economic and technological development. We will consider the main features of innovative development and a transfer of technologies in SCO countries. As note (Edler& Fagerberg, 2017), "There is a narrow perspective, considering invention only, and there is a broader, more holistic perspective, which emphasizes the importance of looking at the entire innovation cycle from the creation of novel ideas to their implementation and diffusion".

3.1. China

Formation of a modern innovative system in China was preceded by reforms of 1970-80 and the national programs of development adopted on their basis. In March, 1986 the state program of development of science and high technologies "Program 863" which defined the priority industries (microelectronics, information science, space, fiber-optic technologies, genetic engineering and biotechnologies, energy saving technologies and medicine) is approved. The program provided carrying out basic and application studies, development of new technologies on the basis of development of the traditional industries. Implementation of this program was quite effective. So, literally in 10 first years of its functioning over one thousand the major scientific and technical achievements were registered, from them 560 developments gained world recognition, 73 – are conferred the state awards, 266 – is patented abroad (Experience of functioning of technological parks of China, 2012).

After two years China started implementation of the research and production Torch program focused on commercialization and industrialization of high technologies. In 1988 the resolution of the State Council of China founded also the first science and technology park — the Beijing High-Technology Industry Development Experimental Zone Zhongguancun (in 1999 Zhongguancun has become the "Zhongguancun Science & Technology Zone" or Z-park).

Z-park not accidentally arranged in the northwest of Beijing. Exactly there are more than hundred scientific and technical institutes and laboratories and also the strongest higher education institutions of China — Peking University and Tsinghua University. They also became basic elements of science and technology park: the universities provided both scientific developments, and the companies advancing them, and qualified personnel for hi-tech business.

The integration component in China has the territorial organization which cornerstone division into the High technology and development zones (HTDZ) created in the mid-eighties of the 20th century and representing scientific and technological parks is.

Now in China there are 120 HTDZ of various level among which 53 – strategic appointment. Among Chinese HTDZ can be allocated the zones located in the central regions (Beijing, Shenyang) and also in coastal areas (Shanghai, Hainan). In one of the central regions the second largest is located and the importance science and technology park of China – Nankh, the received state status in 1991. Shenyang in the territory of which there is a science and technology park has 12 higher education institutions, 30 research institutes, 210 research laboratories, 220 enterprises of new and high technologies function (30 of them with participation of the foreign capital). For lifetime of a zone about 600 new types of hi-tech

products are developed and introduced in production (Experience of functioning of technological parks of China, 2012).

State policy of China is directed to full support of the enterprises of new and high technologies, technopark structures, effective development of the national economy which is guided by own scientific and technical potential. According to the national program adopted in 2006, state agencies are obliged to allocate a certain share of the expenses on products only of the innovative Chinese companies. According to new rules, state agencies can buy foreign products, only if its alternative is not in China (Innovative policy: international experience, 2016).

3.2. Kazakhstan

The foundation to formation of a national innovative system of Kazakhstan was laid by acceptance for the Strategy of industrial innovative development of the Republic of Kazakhstan for 2003-2015. According to Strategy, the main directions of development of the country become:

1. assistance in formation of hi-tech productions, including in creation of an effective system of a transfer of technologies both foreign, and interindustry;
2. creation and support of activity of modern elements of scientific and innovative infrastructure in the cities where there is a network of the scientific and technical and industrial organizations and the enterprises with a high scientific and technological potential;
3. use of the existing scientific and technical potential in development of front lines, in terms of post-industrial economy, the industries;
4. creation of necessary conditions for carrying out researches in the field of the modern scientific and technical directions, such, as: new materials and chemical technologies; information technologies;
5. the improvement of the legislative base directed to stimulation of innovative activity of the scientific and technical and production organizations and enterprises, attraction of investments into the sphere of science and innovations, the fastest entry of innovations into the industry and services sector.

At the initial stage of realization of Strategy for creation of a national innovative system the network of the state institutes of development which included Development bank of Kazakhstan, the Kazakhstan investment fund, Innovative fund, Corporation on export insurance was created.

By 2009 the uniform system of National Institutes of development which list included National innovative fund, Fund of science, the Center of engineering and transfer of technologies, Kazagroinnovation, the Kazakhstan center of modernization and development of housing and communal services was created. Creation in 2000 of Development Bank of Kazakhstan according to which Charter this organization is also carried to National Institutes of development had a considerable impact on formation of a national system.

In March, 2010 the State Program on the Forced Industrial Innovative Development of Kazakhstan for 2010-2014 within which implementation a number of the industry innovation centers, network of the research centers, national laboratories, engineering, design bureaus, four technoparks was created was approved. The task of market implementation of local innovation developments, creation and maintenance of the database for industrial structures was set.

In the Strategic Development Plan for the Republic of Kazakhstan till 2020 the state ensuring forming of a national innovation system on the following principles is defined: 1. creation of the world-class universities and development of university science for forming of the research and development advanced system; 2. financing priority for the state of research and development on the basis of the system of grants. Definition of priorities of research and development according to priorities of industrialization of the country will be carried out by the Highest scientific and technical commission at the Government of the Republic of Kazakhstan; 3. implementation of transparent process of assessment of requests for grants with involvement of experts, including foreign specialists; 4. use of the effective foreign technologies adapted to national requirements.

3.3. Kyrgyzstan

Basic elements of a national innovative system of Kyrgyzstan are formulated in the Law of the Kyrgyz Republic "About innovative activity" (1999). According to the Law, the national innovative policy of the state pursued by the Government of the Republic provides: creation of the state innovative and investment network with the central office which is responsible for preparation and carrying out in life of decisions on national policy in the field of innovations; the approval of the national state innovative programs and offers on participation of the country in the international innovative programs prepared by management of network; priority of government procurement and state orders for products of subjects of national innovative activity; development and implementation by management of network of the actions directed

to carrying out in life of innovative policy, agreed decisions and programs; preparation of the bills of the Kyrgyz Republic governing the innovative relations.

In the Republic the State Council is determined by innovatics which head is appointed the Prime minister by the supreme body of management and coordination of innovative investment activities. Branch innovative infrastructures cope and created by the industry ministries on the basis of research institutes, skilled and selection stations, the state breeding plants and other enterprises which activity is connected with research and implementation works.

The government of the Kyrgyz Republic forms the State innovative and investment complexes which are public institutions on realization of a full innovative investment cycle and created on the basis of the existing versatile higher educational institutions, the scientific, design organizations with the maximum use of their resources. At the same time the central division of a complex headed by its CEO "will be organized mainly on the basis of the leading technical university in the region or other large multidisciplinary state organization having enough the highly qualified personnel, experts and scientists owning the main methods of innovative and scientific activity and also enough rooms and infrastructure for carrying out innovative investment activities in the region" (About an innovative activity, 1999).

In the regions, the most subject to a depression and decline in production, the Innovative centers of the advanced equipment (technocenters) and new technologies (science and technology parks) submitting to industry research institutes and together with them the networks which are a part are created. Infrastructure of the centers can be various and include: scientific laboratory or institute, production, certified and marketing departments, etc.

Elements of formation of a national innovative system of the Republic are put by "The State Program on Formation and Development of the National innovative system of the Kyrgyz Republic for 2006-2010". As elements of the innovation infrastructure of Kyrgyzstan it should be noted also the research establishments which are under supervision of National Academy of Sciences of the Kyrgyz Republic, different scientific research institutes and scientific divisions of higher education institutions, network of the research centers and laboratories at the industrial enterprises which are engaged in applied researches in the industry, technology development zones, a number of technoparks (key - technopark of National Academy of Sciences of the Kyrgyz Republic).

In 2015 with assistance of Fund of infrastructure and educational programs of RUSNANO and the Government of the Kyrgyz Republic there began the work the Center of implementation of innovations (Bishkek) in Central Asia which main objective is implementation of the

innovation products in the territory of the countries of Central Asia and also a transfer of technologies from Russia to Kyrgyzstan.

3.4. Uzbekistan

Carrying out social and economic conversions of the last years caused the necessity of development and implementation of effective scientific and technical and innovation policy of the state which purpose was creation of organizational, economic and legal conditions and mechanisms of development of the scientific and innovation sphere. So, a main objective of the Resolution of the President of the Republic of Uzbekistan "About additional measures for stimulation of implementation of the innovation projects and technologies in production" (2008) was creation of efficient mechanisms on stimulation of development and implementation in production of scientific application studies and the innovation developments, providing more close connection of science and production. The Resolution of the Cabinet "About measures for strengthening of material and technical resources scientific, research establishments and the organizations" (2008) according to which to from the budget of the Republic 10 million dollars were selected for the specified purposes was the same year accepted. In 2009-2010 67 names of the equipment for the sum of 3.53 million dollars were purchased.

Performance of research and development in Uzbekistan is carried out by government institutions, at the same time 20% of the organizations belong to the system of Academy of Sciences, 16% to the Ministry of the highest and so-so vocational education, 15% to the Ministry of Health, 13% to the Ministry of rural and water management, in the system of the Ministry of national education 3% of the organizations are concentrated and 33% of the scientific organizations belong to other ministries and departments (Kadyrova et al., 2011).

It is necessary to emphasize presence at the moment of insufficiently developed mechanism of a transfer of technologies in the industry, weak interrelation of sectors of science, education and business structures, the undeveloped system of commercialization of new knowledge and technologies.

Financing of research and development in Uzbekistan is carried out by mainly State committee on science and technology, including preferential investments into innovative projects for a period of 1-2 years on the terms of recoverability of budgetary funds. At the same time financing of scientific and technical developments is conducted at the level of R&D, and

implementation practice has under itself no necessary financial infrastructure (Kadyrova et al., 2011).

3.5. Tajikistan

Formation of a national innovative system in the Republic was promoted by acceptance of a number of regulations. According to the Strategy of the Republic of Tajikistan in the field of science and technologies for 2007-2015 the science is recognized as one of national priorities. The law of the Republic of Tajikistan "About Science and Scientific and Technical Policy" (1998) provided such organizational and economic mechanisms of scientific activity as plurality of sources of financing of scientific and technical activity, transition to a program and target method of financing, the organization and conducting scientific and technical examination at selection of programs and projects for public financing.

It should be noted also continuous increase in internal costs of research and development (Table 2).

Tab. 2 Internal costs of research and development of the Republic of Tajikistan, millions US dollars

Year	2008	2009	2010	2011	2012	2013	2014
Costs	9.8	11.8	14.1	21.0	21.6	24.3	...

Source: Russia and countries of the world, 2016.

Besides called, formation of an innovative system of Tajikistan and activization of innovative activity was promoted by adoption of such normative legal acts as: Resolutions of the Government of the Republic of Tajikistan "About Council for coordination of research in the field of natural, technical, medical, humanitarian and social sciences" (1996), "About reforming of a system of science funding" (1997), "About the concept of the state scientific and technical policy of the Republic of Tajikistan" (1999); The Laws "About Author's and Allied Rights" (1998), "About industrial samples" (2004), "About inventions" (2004), etc. However at the moment, despite the taken measures for the organization of an institutional component of an innovative system, the regulations fixing the fundamental concepts, criteria, the principles connected with innovative activity and also organizational characteristics of its implementation, a form and methods of the state support are still not adopted, there is no uniform program of innovative development of the country.

3.6. Russia

Innovative system existing in Russia today has a range of features, inherent to transient period. Efficiently developing economy features domination of knowledge-intensive new technologies in the structure of imports, and, in its turn, output of mature technologies domination in the export structure. According to information provided by the Federal State Statistics Service (2018), the structure of exports in technology sector has scientific researches dominating in total of all subject matters of transactions, and other subjects import share prevails greatly over export one. At the moment total import is significantly dominating over export (by 1.6 times) in technology transfer system with foreign partners (Table 3), what means predominant import of technology, which has poor degree of novelty from perspective of the global technology market. So, 86% of developed advanced technologies are new for Russia, and as little as 13.5% of them are brand new for the global technology market (Table 4).

Tab. 3. Technology trade with foreign countries under subjects of transactions in 2017

Subject of the transaction	Export			Import		
	Number of transactions	Subject cost, mln USD	Total annual income, mln USD	Number of transactions	Subject cost, mln USD	Total annual outcome, mln USD
Total	2757	26416	1181	4358	17676	3305
Including for the following subjects of transactions:						
Invention patent	5	0.1	0.1	64	91.4	11.1
Patent license for an invention	-	-	-	1	0.03	0.03
Utility model	117	329	94.8	165	592	106
Know-how	7	5.0	3.9	9	8.0	8.4
Trademark	55	23.7	7.0	130	259	152
Commercial prototype	28	5.2	2.6	314	960	504
Engineering services	4	20.1	20.0	40	3.5	1.4
Scientific researches	1036	25068	720	2133	14475	2133
Others	840	630	178	339	216	83.5

Source: Russia in numbers, 2018.

Tab. 4. Categorized advanced production technologies developed 2017 (items)

Advanced production technologies	Total number of technologies	Category		
		New for Russia	Brand new	The ones using patented inventions during development
Total	1402	1212	190	485
including:				
Design and engineering	417	358	859	163
Production, processing and assembly	417	358	859	163
Automated uploading / downloading actions; materials and parts transporting	34	27	7	14
Automated surveillance (monitoring) devices	134	107	27	44
Communication and control	218	194	24	45
Production informational systems	44	44	-	11
Integrated control and monitoring systems	70	65	5	23

Source: Russia in numbers, 2018.

Technology transfer system basis was established in USSR in 1950s, when significant integration processes were launched in academic and educational environment.

After disintegration of the Soviet Union, in 1990s in Russia, on the one hand, a certain range of educative and scientific structures was formed (university complexes, educational and scientific, and other centers were formed), and on the other hand - against the backdrop of drastic reduction of design and development organizations, experimental plants, scientific and technological services of enterprises (i.e. structures, aimed at ensuring transfer of technology into innovations field), up to the beginning of 2000s growth of research institutions was observed due to creation of new research institutes or fragmentation of the existing ones. This process took place by establishment of new legal entities, but not due to expanding of scientific and research base of universities and enterprises, which, in particular, compose the framework for innovative systems in countries with developed market economies.

All these factors have led to disproportion in an institutional structure of science: while in 1992 there was registered 3437 independent research institutions, design bureaus and development organizations, in 2016 their number reduced to as little as 2003 entities, and number of design and research organizations reduced 19 times (Table 5).

Tab. 5. Organizations, earlier involved into research and development activities

Number of organizations	1992	2000	2005	2010	2013	2014	2015	2016
Total	4555	4099	3566	3492	3605	3604	4175	4032
including:								
Scientific research organizations	2077	2686	2115	1840	1719	1689	1708	1673
Design bureaus	865	318	489	362	331	317	322	304
Design and research organizations	495	85	61	36	33	32	29	26
Experimental plants	29	33	30	47	53	53	61	62
Professional higher educational institutions	446	390	406	517	671	702	1040	979
Scientific, design and development departments within organizations and enterprises	340	284	231	238	266	275	371	363
Other entities	303	303	234	452	532	536	644	625

Source: Russia in numbers, 2018.

In the system of technology transfer which developed as a result of the national economy transformation there is a need of formation of special mechanisms of the organization of the innovative processes providing effective interaction between all its participants – the state, the industrial enterprises, scientific and educational institutions, financial institutions. And in this case the foreign experience in the organization of transfer of technologies considered by us earlier can be useful. A necessary condition for its effective use is formation and development in the conditions of the Russian economy of the corresponding innovative infrastructure. It includes:

1. the legislative base focused on stimulation of innovative business and guaranteeing protection of intellectual property rights;
2. specialized scientific and scientific education centres, scientific (innovative, technological) parks, the centres of a transfer and commercialization of technologies, business incubators, innovative firms promoting transformation of perspective scientific ideas and knowledge to grocery, information and technological innovations;
3. financings of research and development at the expense of a business sector, by creation of legal and financial safeguards of soft loans, various off-budget and joint funds, various measures of the state encouragement;
4. telecommunication infrastructure for the purpose of assistance to information support of the Russian science, an exit of local information networks on global, increases in network of electronic libraries and a system the Internet, expansions of a possibility of access for the Russian scientists to the international databanks;

5. development of network of venture firms and funds, small implementation firms and other elements of innovative infrastructure.

In formation of an effective innovative system in the conditions of Russia the large role is played also by a regional component. Developing the regional innovative policy aimed at the development of a scientific and technological component and the sphere of production, each region forms the approach to a transfer of technologies considering its resource reserves, climatic, branch and other regional features.

4. Conclusions

In spite of sufficient progress in theoretical base of innovative process study, there remains a lot of poorly studied and controversial matters. For example, dynamics of innovative and technological development of countries and regions, application of efficient tools and practices of knowledge and technology transfer, management of innovative processes using different institutional structures etc.

Establishment of required organizational structure, aimed at supporting of the process of acquisition, implementation, and distribution of research and development results involving all participants of the innovative process, i.e. government, science, educational institutions, and business leads to improvement of transfer of technology efficiency. Creation of a system based on integration between scientific, educational and production fields of economy member countries of SCO will help forming of competitive high-technology production facilities, improvement of structure of exports due to increase of high-technology share in it, and decrease of raw materials sector, improvement of the state stand on the global technology market.

As for the Shanghai Cooperation Organization member countries, it should be noted that increase in efficiency of a transfer of technologies is promoted by formation of the necessary organizational system focused on ensuring process of receiving, realization and distribution of results of research and development with involvement of all participants of innovative process – the state, science, education, business. Creation of the system based on integration of scientific and educational and production spheres in SCO countries will promote formation of competitive hi-tech products, improvement of structure of export due to increase in a share of innovative products in it and decrease in raw orientation, to increase in the status of the countries in the world market of technologies.

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