RESEARCH

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KEY TENDENCIES IN SCIENTIFIC AND TECHNICAL (INNOVATIVE) ACTIVITIES OF RUSSIAN INDUSTRIAL COMPANIES

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Abstract

The article offers the analysis of expenditures on technological innovation in Russia and abroad. The author outlines the main reasons of the low level of technological development of Russian industrial companies. A number of organizational and economic measures to create conditions for technological development of the Russian economy are considered.

In recent years, there was an essential increase in output of innovative products, works and services that coincided with the increased ratio of volumes of technological innovations to their costs. However, the expected decrease of this ratio in the coming years may cause slower growth of volumes of innovative production that requires drastic measures, especially aimed at restricting key factors impeding innovative activities. These factors include lack of own funds, high cost of innovations, lack of financial support from the state, high economic risk and low innovative potential of the organization.

Keywords: *technological development, innovative technologies, innovative performance of industrial companies, innovative performance, output, cost structure, technological innovations.*

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Competitiveness of the economy of any state and its economic subjects is provided solely by the integral performance of the following sectors: science, technology and production. The system managing and coordinating these sectors and numerous subsectors is the innovation management system. The specific feature of the innovative development of the economy is the science being an integral part of the industrial production and productive power (intellectual capacity).

At present, Russia enjoys the sufficient potential to move its economy to innovative development, despite the current geopolitical and economic challenges. Some of the potential has been formed in the Soviet period when the system of the effective economic performance (hereinafter SEEP) and a comprehensive program of scientific and technical progress (hereinafter CP STP) were developed.

The first theoretical investigations to optimize the development of industries were attempts to improve the plan system, and this led to the development of the system of the effective economic performance (SEEP). The SEEP theory was developed by Soviet economists and mathematicians: L.V. Kantorovich, V.S. Nemchinov, V.V. Novozhilov, A.G. Aganbegyan, A.G. Granberg, N.Ya. Petrakov, N.P. Fedorenko, S.S. Shatalin, V.A. Volkonsky, A.I. Katsenelinboigen, V.F. Pugachyov, Yu.V. Sukhotin, etc. The SEEP program was to be implemented under the effective economic planning and management of the economy, and this implied key areas of scientific research and experimental work and the stages of development and implementation of the effective planning and management system. The

preliminary project should be developed on a unified approach to the national economy as an integral economic system. The conditions for the economy to run effectively included the following:

- to combine centralized planned management and economic independence of business units;
- to coordinate interests of economic components with the objectives of development of the entire economy, as well as to use economic instruments (price, income, funds, loans, etc.) to develop and implement national economic plans;
- to find out ways and forms to implement economic and mathematical methods and computer technologies to the planning and management [4].

The experience showed that it was just a theoretical model, not applicable in practice.

The SEEP system was replaced by a comprehensive program of scientific and technical progress (CP STP) of the USSR, which was draws up every five years for a period of up to twenty years. The program's authors were prominent scientists and economists: L.I. Abalkin, K.I. Taksir, M.V. Keldysh, V.A. Kotelnikov, B.E. Paton, S.M. Tikhomirov, V.K. Faltsman, A.I. Tselikov, A.P. Yarkin, etc.

The comprehensive program of the scientific and technological progress was developed to scientifically prove the necessity of the long-term scientific, technical and socio-economic policy of the state. The importance was given to the issues of the defense capability and the country's position on the world arena based on the "comprehensive intensification of the economy" and "sustainable use" of financial, environmental and labor resources. This CP STP embodied the concept of the unity of science, technology and production, and was considered as a solution of social and economic problems. In this regard, it is necessary to compare the trends in scientific and technological changes in the economy, characteristic for the Soviet period (1970s–1980s) and for the present day. This necessity is urgent because the comparison enables revealing the "bottlenecks" of the current national innovation system and, using the results, identifying the opportunities to solve them. There are reasons to believe that the previous experience of scientific and technological development of the state economy may be applied now with a certain degree of modifications (see Table 1).

Table 1

Comparison of the scientific and technical progress programs / systems of Soviet and present periods (developed by the article's author)

Key tendencies	SEEP	CP STP	NIS (National Innovation System)
1. Effective use of all resources of the society	+	+	+
2. Programme-oriented planning and management	+	-	-
3. Economy is a hierarchical self-developing system	+	+	-
4. Centralized management	+	+	-
5. Scientific and technical progress based on plans	+	+	-
6. The principle of the unity of science, technology and production	-	+	-
7. Large-scale coverage of industries	+	+	+

According to the findings of the famous scientists, one can further develop the principles and methods of the innovation management. According to the data in Table 1, one should pay attention to the following fact: the comprehensive program vividly demonstrates the unity of science, technology and production. This, in our opinion, predetermined the success of the scientific and technological development in the Soviet period. At present, this unity is not observed, and we believe that this is the main reason for the slow innovative transformation of reproduction factors. Figure 1 clearly shows the downward dynamics of the share of industrial companies implementing technological innovation in the period from 2001 to 2013.

Trends of growth of total expenditures on technological innovations in industrial production in Russia are shown in Figure 2.

Analysis of expenditures on technological innovations in Russia and in the world according to the type of the innovation activity (Table 2) shows that the considerable share of expenditures (over 50%) in Russia accrues to the purchase of machinery and equipment, while the purchase of new technologies accounted for by not more than 2% and the own technological development – about 10%.

The countries with developed market economies have a different expenditure balance: the focus is put on the own research and development (Germany –

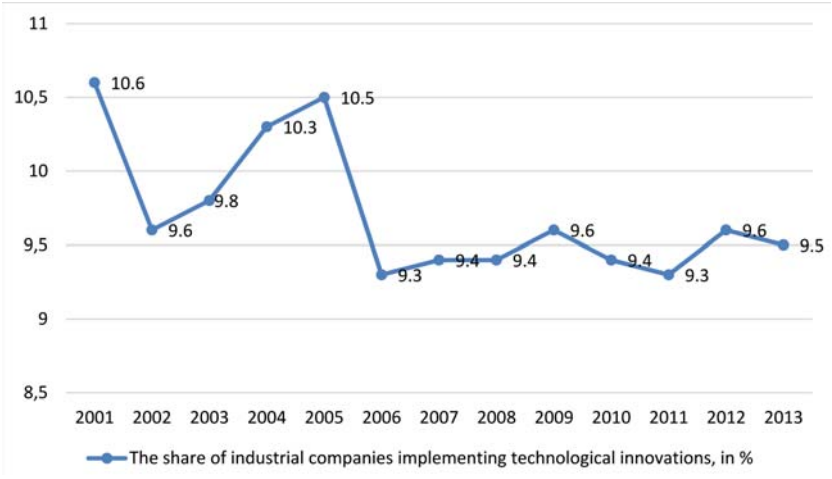

Fig. 1. The share of industrial companies implementing technological innovations, in % (made up by the article's author on the basis of [6])

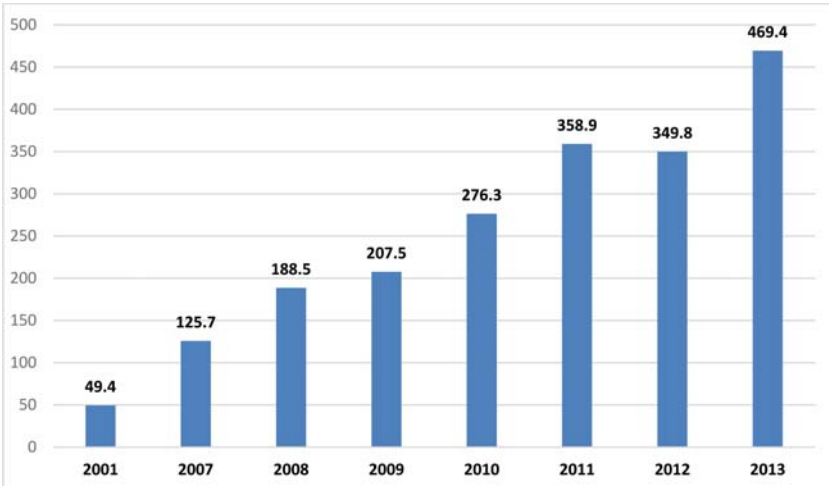

Fig. 2. Expenditures on innovation development of technologies (made up by the article's author on the basis of [6])

47.2%, France – 68.9%, the Netherlands – 63.2%, Norway – 61.0%, Sweden – 64.4%), while the share of expenditures on the purchase of machinery, equipment and software does not exceed 25% (Germany – 24.4%, France – 9.7%, the Netherlands – 19.9%, Norway – 15 5%, Sweden – 17.5%).

High expenditure growth causes the problem of attracting additional financial resources to the economy. This is illustrated in the diagram in Fig. 3.

Trends in R&D financing, as reflected in this figure, prove the decline of revenues in all high-tech industries in Russia. Funding of R&D activities fell by an average of 37%.

In the non-CIS countries, the share of expenditures of the corporate sector on research and development in the national expenditures on R&D activities exceeds 65-70%. In Russia, the situation is opposite, and the corporate sector finances only 20% of R&D expenditures. According to analysts, most of the projects implemented by the business are motivated by the desire to strengthen their competitive advantage or reduce the technological gap with their foreign competitors. Businesses lack motivation to occupy new market niches or expand into new markets. In Russia, the trend to fund science in the scientific and production sector from the federal budget remains. For example, according to the data published on the official website of the Federal State Statistics Service, expenditures on basic and applied researches have increased: in 2000 - 17.4 million RUB, in 2005 - 76.9 million RUB, and in the beginning of 2012 – 313.9 million RUB (0.57% of GDP and 2.87% of total expenditures of the federal budget). Absolutely different trend can be observed in the technologically advanced countries like Japan, Israel, China, Korea, the USA, Switzerland, Germany, etc. where the share of the corporate sector in the financing of science prevails over the public funding.

The trend of stagnation of the scientific and technological (innovative) performance of industrial companies has been observed for many years, and this is an evidence of permanent problems in the scientific and production sector. Of all the companies implementing technological innovation, the majority (32%) accrue to production of coke and petroleum products, electronic and optical equipment (25%), chemical industry (22%), and 4% is accounted for by electricity production (Fig. 4).

The key factor impeding the scientific and technological (innovative) performance is the underdeveloped innovation infrastructure, which is understood as the complex of the entities of scientific and technical (innovation) performance (institutions, organizations

Table 2

Structure of expenditures on technological innovation in industrial companies according to the type of innovation activity, in% [6]

	Total	Own research and development	Research and development made by third parties	Purchase of machinery, equipment and software	Purchase of new technologies	Other expenditures on technological innovations
Russia	100	10.3	8.3	56.7	1.8	22.9
Belgium	100	30.3	13.4	34.8	21.5	–
Bulgaria	100	6.3	1.3	88.8	3.6	–
Germany	100	47.2	8.9	24.4	2.8	16. –7
Greece	100	13.3	2.3	83.0	1.4	
Denmark [1)]	100	64.0	16.8	16.1	...	–
Ireland	100	27.4	4.2	63.9	4.4	–
Spain	100	39.9	19.4	29.6	2.9	8.2
Italy	100	35.3	7.4	51.8	5.5	–
Luxemburg	100	74.1	1.3	21.8	2.8	–
the Netherlands	100	63.2	15.0	19.9	1.9	–
Norway	100	61.0	20.3	15.5	3.3	–
Portugal	100	20.0	6.3	72.4	1.4	–
Romania	100	13.9	3.7	80.5	1.9	–
Slovakia	100	7.2	2.5	89.2	1.1	–
France	100	68.9	19.8	9.7	1.6	–
The Czech Republic	100	18.3	14.4	43.5	23.7	–
Sweden [1)]	100	64.4	...	17.5 2.3 –		

[1)] Indicators do not make up 100% in total because information on certain types of innovation activities is confidential.

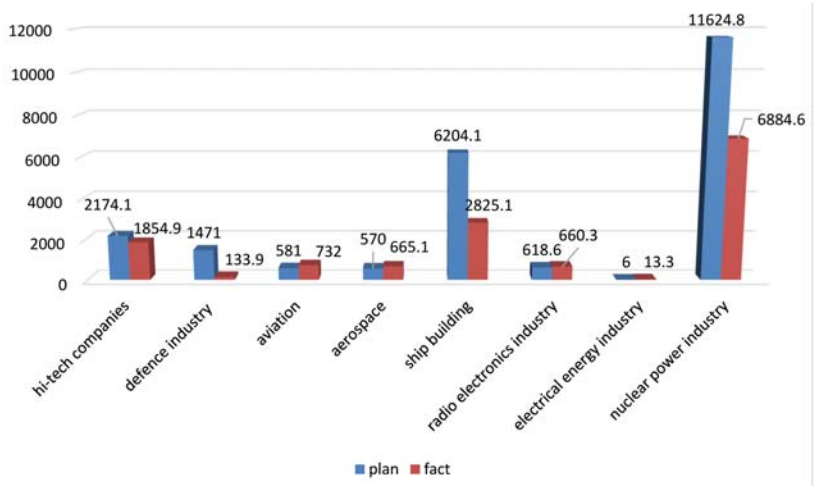

Fig. 3. Trends in financing R&D activities (made up by the article's author on the basis of [7])

and individuals) providing favorable conditions and opportunities to produce and implement innovations. According to experts, the second most important problem is the lack of qualified personnel able to carry out research, development and subsequent implementation of the results of scientific and technological activities. A significant role in the statistics given belongs also to the legal (legislative) base and underdevelopment of the technology market.

The combination of external and internal factors of scientific and production activities influences both the internal development of the scientific and production sector and the investment attractiveness of the country in general.

The negative trend is observed in the dynamics of the number of personnel engaged in researches. In 2012, this number was 81% to the level of 2000. It should be noted that much attention was given to the development of the scientific sphere in the Soviet Union and by the 1990s the industry employed about 2 million researchers (over 1 million of them worked

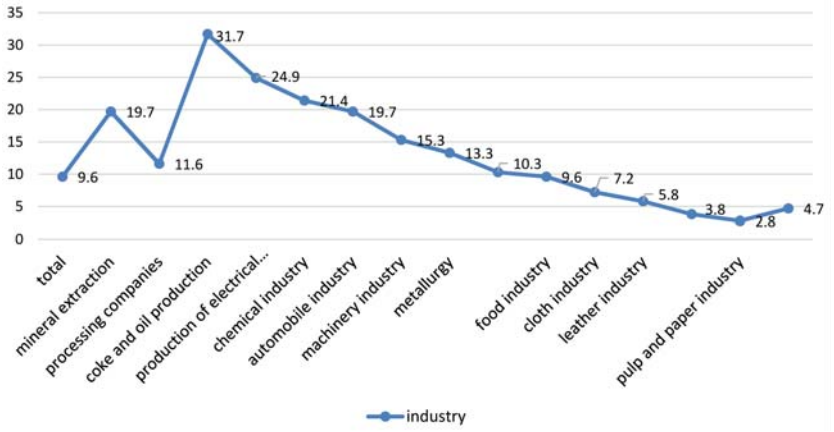

Fig. 4. Share of technological innovations according to the activity types in 2013 in total industrial output (made up by the article's author on the basis of [7])

in the territory of modern Russia). At that time, this indicator was the highest in the world. Research activities were actively conducted in three sectors: academic, university and industrial. The industrial sector dominated. It is important to underline that the scientific and production (innovation) chain was not interrupted, and most of the innovations of scientific research institutes, R&D companies and other structures were implemented directly in production. Currently, the negative trends are observed in all areas of scientific and production activities.

Every year the number of patents grows in Russia, however, the number of patents from foreign applicants exceeds that from Russian ones.

The Russian science is far behind the advanced world: the first years of the country's sovereignty saw the brain drain, and Russia fell far behind the West in the scientific achievements. The government is trying to motivate the business sector.

The forecast of the scientific and technological development till 2030 lists the priority areas: information and communications technologies, biotechnologies, medicine and health, nanotechnologies and new materials, natural resources, transportation, aerospace, energy efficiency and preservation.

Development plans inspire hope that the scientific potential of the country will be restored, but one should remember that the science development programs have been set up for a long time already, but the past decade saw reduction of the country's scientific potential, and some achievements are insufficient in general, so the Government is unlikely to focus on implementation of these tasks under stagnation and gradually growing problems in the economy.

The analysis reveals the following key reasons for the low level of technological development of industrial companies and their weak demand for innovative technologies:

1) lack of competition in the domestic markets;
2) underdevelopment of the domestic market of innovative technologies;
3) it is very difficult and often impossible to import advanced technologies;
4) lack of the necessary comprehensive Russian-made equipment (the machine tool industry was ruined in the 1990s and it is being restored now with great difficulty);
5) existing restrictions on the import of advanced equipment;
6) companies lack financial resources for technological development; the problem of access to affordable credits (high interest rates, short term lending);
7) lack of motivation and workable economic conditions stimulating technological development of companies, weak state support measures;
8) a low level of technological literacy of the companies' leaders;
9) most companies lack long-term plans and innovation development programs;
10) underdeveloped technological infrastructure in regions, poor engineering support of technological upgrade of companies.

Recognizing the crucial importance of the problems, the country's leaders have taken a number of organizational and economic measures to create conditions for technological development of the country in recent years. The Russian President established the Council for Modernization and Innovative Development of Russia. The Government decree dated 19 March 2014 No. 398-p approved a set of measures to avoid the use of outdated and inefficient technologies, and declared the transition to the use of the best available technologies and implementation of advanced technologies.

In order to focus on the development and use of advanced technologies and considering the interests of the state, science and business, the Russian Government in 2010 initiated the launch of the

mechanism of development of national technology platforms based on a public-private partnership. By now, 34 Russian technology platforms on key technology areas [5] have been made, and they will determine the technological development of the country in the short- and long-term future, including biotechnologies, nuclear and radiation technologies, new materials, aerospace technologies, ICT, renewable energy technologies, etc. Within the framework of technology platforms, programs of strategic research and development of advanced technologies are developed actively involving businesses, the activities of companies – participants of the platforms are coordinated and public and private financial resources are accumulated.

An important role in the innovative development of industrial companies belongs to the implementation of the Research and Development on Priority Directions of Development of Scientific-Technological Complex of Russia for 2014-2020 federal target program approved by the Russian Government Decree of 21 May 2013 No. 426 [1]. The federal program is an instrument for subsidizing companies to conduct research in the six priority areas of science, technology and engineering in Russia [1]:

- nanosystem industry;
- information and telecommunications systems;
- life sciences;
- rational environmental management;
- transport and space systems;
- energy efficiency, energy preservation and nuclear power.

Total funding of the federal target program is 239,062,621,000 RUB.

In June 2014, the competitions of two- and three-year applied researches aimed at developing products and technologies, as well as of projects for the implementation of applied researches under technology platforms in priority areas were finished.

To finance projects under these competitions budgetary funds amounting to 12.15 billion RUB were allocated [3].

715 Russian companies participated in the competitions: 191 educational institutions, 187 limited liability companies, 153 research institutions, 50 closed joint stock companies, 41 joint stock companies, 23 federal state unitary companies, and 70 other companies.

It should be noted that the competition for projects to implement applied researches saw much more applications from educational and scientific institutions than from businesses because business is not able to independently solve the problems in the field of applied researches due to the lack of necessary structural units.

Thus, certain steps in the technological development of industrial companies and creating demand for innovative technologies in Russia have been made: state corporations, hundreds of technology parks and business incubators have been established, the Russian Venture Company and the Bortnik Foundation operate, and a system of state support for innovation through co-financing of regional programs functions. All this provides a strong positive effect but the exact criteria to assess the effectiveness of this work have not been worked out yet. The solution of the important state task – to stimulate demand for innovative technologies – will significantly change the situation in the field of innovative development of industrial companies in Russia.

Innovative development in Russia will only be possible under the effective cooperation and coresponsibility of science, government and business. Only business can and should provide the market character in the technology sphere helping government institutions take right decisions and make right laws. However, in the future, despite the significant role of private companies in the implementation of innovative technologies, the coordinating role of the state should be preserved, thereby ensuring maximum benefit for the state from sales in the high-tech product market.

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ОСНОВНЫЕ ТЕНДЕНЦИИ НАУЧНО-ТЕХНИЧЕСКОЙ (ИННОВАЦИОННОЙ) АКТИВНОСТИ РОССИЙСКИХ ПРОМЫШЛЕННЫХ КОРПОРАЦИЙ

Катрина Бениковна Доброва

Аннотация

В статье проведен анализ затрат на технологические инновации в России и за рубежом. Выделены основные причины низкого уровня технологического развития отечественных промышленных предприятий. Рассмотрен ряд организационных и экономических мер по созданию условий технологического развития экономики страны.

В последние годы произошло существенное увеличение объема производства инновационных товаров, работ и услуг, что совпало с ростом соотношения объемов технологических инноваций и затрат на них. Однако ожидаемое сокращение данного соотношения в ближайшие годы может привести и к замедлению роста объемов инновационного производства, что требует принятия кардинальных мер, особенно по ограничению действия основных факторов, препятствующих инновационной деятельности. Это недостаток собственных денежных средств; высокая стоимость нововведений; недостаток финансовой поддержки со стороны государства; высокий экономический риск; низкий инновационный потенциал организации.

Ключевые слова: *технологическое развитие, инновационные технологии, инновационная активность промышленных предприятий, инновационная активность, объем производства, структура затрат, технологические инновации.*

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