

# Innovative Activity of Chemical Industry in Russia and Prospects of Development

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**Abstract:** Innovative development is a basis of economy modernization. Countries occupying a leading position in the field of innovation can influence the economic development process. Existing innovative development of the Russian economy is insufficiently active. The article analyses the modern state of the chemical industry, identify the causes of the decline in innovative activity during the last twenty years. It was determined that the problem of attracting financial, technological and human resources is the main obstacle to the development of the domestic economy according to the innovative program. There are also reviewed prospects of innovative development of enterprises of chemical industry.

**Keywords:** Chemical Industry, Innovative Activity, Development, Investment

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## 1. Introduction

In today's globalized world a country's economic growth and improving the quality of life of its population is inextricably linked to innovation and innovative activities. Sharp mainstreaming of innovative activities, i.e. activities on the use and commercialization of innovations [1], and the permanent need to increase the competitiveness of domestic products has set new tasks before the country's leadership and heads of industrial enterprises – management of such activities.

The basis of modernization of economy is the innovative development of enterprises and, in particular, the development of innovative projects. It is known that countries which occupy the leading position in the innovation sphere have an opportunity to influence the development of the economy. Today, the development of innovative projects, industrial enterprises had to be strengthened.

## 2. Theoretical Background

Innovation activity is a continuous process. With the development of the world economy innovation process also evolves. Firms constantly make changes to products and processes and collect new knowledge, but a dynamic process is more difficult to measure than static activity.

Innovation-active firm is the firm that demonstrated innovation activity during the survey, including continuing and discontinued. In other words, the firm who conducted any activity associated with the creation of innovations, recognized by innovation active – regardless of whether the activity has led to the actual emergence of innovations [8].

Schumpeter believed that for the entrepreneur introducing innovations, the only way of obtaining permanent income is continuous innovations. Indeed, the growth of volume of innovative goods, the cost of innovation increases due to the growth of financial results, profitability, turnover. Therefore, it is impossible not to agree with the statement of Schumpeter: "Entrepreneur is the instrument of progress and profit is reward for innovation, what motivates entrepreneurs to innovate, and thus the entrepreneur-innovator leads society to continuous progress" [2].

Innovation in the chemical industry can be divided into two types:

- active innovation is embedded in technology companies, the development of which they participated directly in the initial stage, performing their own forces or by funding third parties; it also introduced the-shelf technology, but which are new in the world, which previously was not any where introduced;

- passive innovation is embedded purchased (borrowed) technology, which is amongst the progressive in the industry,

protected as intellectual property, but for a long time replicated in the world [3] [4].

Technological borrowing (passive innovation) is dominant at this stage for the chemical industry in the Russian Federation. The use of passive innovation allows in a relatively short period of time to increase production volume and competitiveness of producers, preparing to deploy active innovation.

In the initial period of the innovation life cycle when funds are invested in the development of new technologies, the return increases so slowly that is causing continuous frustration. However, with the development of innovative efficiency increases dramatically. In the final phase increased productivity slowed down again, and every successful innovation takes more resources. Of course, a firm must constantly monitor the progress of opponents: when one of them approaching the stage of effectiveness of innovation, and other market participants usually start to carefully investigate alternative technologies that can provide a take-off their own curves. The resulting technological gaps can surprise tarried manufacturer. Technological gaps will occur more often, therefore, firms, which always ready to attack, will gain a significant advantage [5].

### 3. Industry Situation

These trends affected the chemical industry as one of key industries of Russia. Currently, its products are highly integrated to other sectors of the domestic industry: medicine, agro-chemicals, construction, household chemicals, cooking, etc. With the needs in products its production continues to grow, presenting new demands in terms of quality and quantity, width and depth of assortment.

Chemical industry of Russia can be attributed to one of the basic sectors of the economy. The enterprises of the Russian chemical industry produce more than 70 thousand items of different products. The main consumers of these goods – agriculture, metallurgy, machinery, light industry [14].

Currently, despite the fact that a significant part of chemical industry products produced in the Russian Federation is advanced and modern, it is not radically new. At the same time, Russia is a country with a powerful scientific and technical base, providing more than 73% of the world's innovations in the economy of developed countries. Unfortunately, in recent years Russia has developed mainly due to the sale of natural resources (oil, gas, etc.), not the results of their processing that much more profitable, as well as in the form of cheap loans from foreign banks [6].

In the structure of expenses for innovations in the world (45 types of industries) chemical industry ranks 7th - 4%. In the structure of expenses for innovations in the Russian Federation the chemical industry is also ranked 7th of 18 types of industries (7%). This indicates the prospects of development of chemical industry and the need to increase Russia's share on the world market.

The chemical industry occupies a leading position on the level of productivity in the world. It is second after

pharmaceutical industry, ahead of automotive, electronic and other industries. However, in Russia it is not seen as an integral part of competitive production, which is profitable, but as one of the types of business that is not profitable, as, for example, the supply of gas or oil.

The chemical industry is one of the most dynamically developing branches of the Russian industry. In recent times the decline in production at the end of the year the industry saw in 2009. After that, for six years chemical production continued to increase despite periodic accidents on the largest chemical enterprises, the plummeting commodity prices on world markets, currency fluctuations, instability of the domestic market and the difficult economic situation in Russia and beyond its borders.

Unlike most industries, the chemical industry in 2013 not only increased but also accelerated its growth. In 2010 in comparison with 2007, the industry increased production by 3.9% and in 2013 this figure rose to 4.9%.

Chemical production started in 2014 with a very active growth. In January, the growth in annual comparison was 7.7% in February - 14.8%. But then the dynamics of production was rapidly deteriorating. In April-August monthly growth rates were consistently negative. In General, the first eight months of production growth in industry amounted to, according to Rosstat [9], only 0.3%. One reason for this is the deterioration of the export statistics. The export of chemical production in monetary terms fell by 5.5%. The rate of growth in the industry in 2014 was the lowest in the last five years.

In 2015, the chemical industry has demonstrated the best result in the last five years. According to Rosstat [9], the growth of chemical production in comparison with January-March 2014 amounted to 6.7%. The chemical industry has been growing for several years. Consider the dynamics of the industry in 2016.

**Table 1.** Dynamics of chemical production in Russia in the first half of 2016, %.

Fertilizer	1
Nitrogen	10
Phosphorus	4
Potash	-9
Anhydrous ammonia	7
Soda ash	4
Caustic soda	-1
Plastics in primary forms	1
Polymers of ethylene	8
Polymers of propylene and other olefins	3
Polymers of styrene	2
Polymers of vinyl chloride and other halogenated olefins	-16
Synthetic rubber	-2
Chemical fibers and yarns	17
Synthetic fibers	14
Artificial fibers and yarns	0, 1

As can be seen from the table 1, the industry leaders, according to Rosstat [9], in the first two quarters of 2016 are: the production of ammonia, which showed 7% increase; production of chemical fibers and yarns with an index of 17% and polymers of ethylene, which added 8%.

By the end of 2016, chemical production in Russia increased with approximately 4%. The growth of production in the industry was the seventh year in a row. Over a seven-year period the volume of production in the industry grew by more than 40% - one of the highest rates among all sectors of Russian industry. The last time a breakthrough in the chemical industry was observed in the USSR in 1981-1987 - then the industry's production increased in seven years by 38% [10].

One of the main factors of growth is investment in the creation of new facilities and upgrading old ones. Over the last seven years of fixed capital investment of the chemical industry amounted to 1.5 trillion rubles. While the estimated amount of investment in 2016 in nominal terms and 3.7 times higher than the 2010 result [10].

For the effective development of the chemical industry in our country, there must be use the effective mechanism of forecasting. Economic reform 1990-2000 has reduced the share of innovative products in Russia's GDP from 1.12% in 2006 to 0.93% in 2013, the share of innovative products in Russia in 2013, took the 312-th place in world production.

Leading positions in this region belong to the countries, the GDP growth in which is determined by technical development up to 80-90%. The situation in the country in the period from 1990 to 2013 led to a decrease in 1,8 times in the number of scientific organizations and enterprises, introducing innovations. It indicates weakness of the material-technical base and staff innovation that leads to growth of their imports [7].

The key issue in improving the efficiency of the country is attraction of available financial, technological and human resources. The solution to this problem requires appropriate government loans for innovative technologies, the volume of which is from 50% to 70%, which allows organizations to attract Bank investment.

At the present stage in Russia more than 50% of entrepreneurs are investing in the modernization of products production technology, 30% contributes to the release of new products, and only 20% invest in research to develop entirely new products.

The low level of corporate R&D expenditures in Russia is often associated with the insufficiencies of the process of technological upgrading, meaning that businesses must first modernize production and replace equipment in factories, and then go to innovation. However, experience shows that the large investment and innovation do not compete with each other, but instead accompany each other. Those businesses, that actively invest in recent years, carry out innovations of high quality. The highest proportion of companies never took any investments (44%) among those who have never engaged in R&D, haven't introduced new products and technologies [11].

The possibility of transition of the domestic chemical enterprises on the path of sustainable development is constrained by the high degree of depreciation of fixed production assets and technological backwardness. The operating life is 20 years or more for a significant part of the

equipment. For comparison, the equipment life of the USA chemical industry averages about 6 years. The degree of wear of basic production assets of Russian chemical complex as a whole is about 54%, and equipment with 67.2% for certain types of equipment in the production of soda ash, polystyrene and copolymers of styrene, the degree of wear is over 80%, some is up to 100% [12]. In order to change the situation radically, we need a significant infusion of investment. In today's environment of Western sanctions, lack of domestic sustainable investment mechanisms it is practically impossible to expect any stable investments not only in chemical industry but also in other sectors of the economy [13].

The development of chemical products is the most important criterion for the technical development of the country. It is associated with the demand and requires a corresponding development of high competitiveness of chemical products and the rate of its growth and development. Therefore, the aim of development of chemical production of Russia for the period under review, is securing the necessary release, the quality and range of chemical products corresponding to the demand of the domestic and world markets, on the basis of technical re-equipment of existing and creation of new manufactures on a modern technical basis.

In the current conditions of development of the country's chemical industry does not have the appropriate industrial and technological base. Consumption of certain types of chemical products per capita, is 8-10 times lower than in Germany, France, England. The gap in competitive advantages due, primarily, weak innovative activity and low efficiency of the investment process in the chemical industry.

This situation is caused by the effectiveness of export of goods with a low processing within the last 20 years, the sharp decline in domestic demand. The current situation on the world market does not encourage exporters to improve product quality and development of chemical enterprises. In addition, an important deterrent to the development of the industry is the discrepancy between the structure of chemical industry Russian chemical complexes of other countries. Despite this, in the chemical industry there are opportunities to create the development of the industry, including: the availability of energy raw materials, water and other natural resources; the growing capacity of domestic market; the availability of appropriate production and scientific-technical potential.

## 4. Development Prospects

Significant changes in the geopolitical and macroeconomic realities, the low value of the ruble, reveal the chemical complex of Russia new opportunities and prospects [15]. The main and most urgent task of the sector is to attract investments and increase a competitiveness, thus the chemical industry will become the locomotive of economic development. This requires modernization of production facilities of existing enterprises, construction of new

processing factories based on modern technologies and the use of scientific and innovative approach. Without revival of sectoral science Russia has a chance to purchase the technology and projects abroad in the future.

There is a problem in the innovative development of enterprises of chemical industry, and, consequently, in the development of innovative projects.

Technological development, its success largely depends on external conditions and on the adaptation of enterprises of the chemical industry to trends in the global and domestic market.

From 2017 on territories of advancing socio-economic development, there is planned the establishment of petrochemical clusters. Such cluster has already been created on the basis of enterprises “Usoliekhimprom” and “Usolie-Sibirsky Silicone” located in the Irkutsk region. The cluster will include acetylene production of calcium carbide and chloride complexes, as well as the production of silicon-containing products, which are used in solar energy and semiconductor industry.

In the future there can be expected the emergence of such clusters on the basis of the large factories of the chemical sector, located in the Urals, in Solikamsk, Nizhny Tagil. The plans also include development of existing and creation of new petrochemical clusters in Nizhny Novgorod region, Bashkortostan, Omsk. With the development and creation of such clusters, the dynamics of chemical production growth will continue in 2017-2018 and possibly increase to 6-8% annually.

Implementation of prospective innovative projects of the chemical complex will remove structural restrictions on the development of industry and launch production of brand new consumer properties of products. This will create the conditions for effective import substitution and reduce dependence of the domestic market from the influence of foreign companies. It is estimated that the import volume of the chemical group of products can achieve by 2020 about 65 billion USD, and by 2030 – about 78 billion U.S. dollars.

One of the features of the chemical industry is that almost all of the latest developments is subject to high risks of rapid obsolescence of new products and technologies of the chemical industry, often change the prevailing view of profitability as one of the determinants of investment and innovation attractiveness. On the other hand, a high payback of capital investments and the risk of non-repayment within the given timeframe makes unattractive the process of

creating and implementing innovative engineering and technology.

Features of activity of innovative enterprises in the chemical industry are: the combination of different batches of raw material and accounting for the characteristics of continuous production processes; the presence of secondary, auxiliary and reusable resources; a plurality of the units of measure for one material; the figures of losses and waste; unpredictable variations in the quality; performance evaluation; the necessity of considering the timing for safe storage - many of the processes are continuous or very prolonged and interconnected with subsequent chemical manufacturing processes.

There are factors that objectively hindering the development of the entire chemical complex and small venture companies, including: the shortage of investment funds, high level of equipment wear, low consumer product quality, limited range of a number of domestic chemical products, the poor infrastructure of the internal market, the unwillingness of the consuming sectors of the economy to the processing and use of some chemical materials, etc. In connection with the accumulated problems of chemical science, the main task is to provide high quality and high technologies.

## 5. Role of the Government

The government of the Russian Federation presented the program of development of chemical complex till 2020 according to which it is planned to increase the production of chemical products, to raise the level of chemical products quality to the world level at the expense of production of new high-tech chemical products with high added value, so there is projected an achievement of the share of innovative technologies in chemical production up to 30 - 50% of the world level; the implementation of import substitution for the growth of internal market significance in the chemical complex of the country. Sustainable development of the chemical industry leads to the formation of a number of necessary internal and external conditions.

Earlier the development strategy of chemical companies did not provide the breakthrough for large-scale investment projects. Up to 2015 the forecast used prices for raw materials, fuel, energy and transport adopted in the strategy to 2020, providing continuity of indicators for the future (table 2).

**Table 2.** Chemical enterprises innovative development goals characteristic.

№	Goal	Criterion	Indicators	
			1 <sup>st</sup> stage 2007-2015	2 <sup>nd</sup> stage 2015-2020
1	Technical re-equipment of existing and creation of new industries	Physical depreciation of fixed assets, %	40,0	30,0
		Update coefficient, %	5,5	15,0
2	Development of exports and domestic market of chemical products	Export volume, bln USD	16,3	18,1
3	Increase of new technology goods production	Share of new products in the structure of chemical enterprises, %	-	30,0
4	Growth of chemical enterprises innovative activity efficiency	Volume of new products shipped, bln RUB	74,0	185,0

In the first stage of chemical enterprises development scenario (2007-2015) there was planned mainly the reconstruction of existing facilities and only a small input of new productions. But at the second "innovative" stage (2015-2020) there is envisaged the commissioning of new capacities and creation of chemical products competitive production.

There is planned introduction of new technologies in all sub-sectors of the chemical industry, which will enable to increase the proportion of high value added in the structure of production to 15-20% (in 2007 it is amounted to only 3.7%). It is projected that the cost of production of chemical enterprises in comparable prices of 2007 will grow from 2011 billion in 2007 to 5756 billion RUB by 2020, and the volume of chemical production (in 2007 prices) will increase in 2,83 times.

In the innovation sector of the chemical industry, effort and government resources should be directed primarily at creating the infrastructure of innovation, the formation of modern, innovative market, regulatory framework for innovation activities. Source of resources for the implementation of industrial and scientific-technical policy of the chemical complex should be a system of recurrent funding for innovative projects and applied research performed with the involvement of state budget funds on a competitive basis.

In today's situation in Russia the accelerated industrial development required the creation of a system of priority industrial projects of different scale. In the framework of the project as an industrial policy tool fails to connect strongly administrative, financial, structural, technological and market resources.

The state in today's terms must take on the role of master agent to support innovation in small businesses through the development of a system of business incubators for high-tech projects, the provision of budget grants on a competitive basis, venture financing, facilitating the access of small enterprises to the stock market. The great importance for the development of venture capital mechanisms is the creation of special regimes of tax incentives for investors in small businesses. Source of resources for the implementation of industrial and scientific-technical policy of the chemical complex should be a system of recurrent funding innovative projects and applied research performed with the involvement of state budget funds on a competitive basis. In the conditions of limited possibilities of budget financing of innovation is increasing the need to attract additional funds from the budget and extra-budgetary funds. Virtually undeveloped reserve is the involvement of Bank capital, which is necessary to develop a system of state guarantees.

The probability of success of technological development largely depends on external conditions (market, etc.) and adaptation of chemical companies to trends in domestic and world markets.

The development of chemical enterprises is impossible without increasing their investment attractiveness by

reducing the risks and growth rate of chemical production at least 5% per year. The necessary condition is the state support of development of chemical enterprises and corporations based on the growth of their efficiency and deeper processing of raw materials through the use of IT technologies.

## 6. Conclusion

According to the foregoing, it can be assumed that for the development and increasing the number of innovative projects in the chemical industry it is necessary to:

- a) increase participation of science in the development of this industry;
- b) provide a concentration of scientific and technical potential of the industry;
- c) create favorable legal and economic conditions for development of small innovative entrepreneurship;
- d) form a common strategy for the promotion of innovative projects;
- e) optimize the costs of enterprises in the development of such projects;
- f) create favorable conditions to attract staff.

The growth and development of the industry, employed about 380 thousand people, will give Russia a huge number of new jobs. Chemical industry of Russia, which has made a great contribution to the maintenance of economic positions, started to take the first steps in its development in the crisis conditions, can and should become the future growth driver of the domestic economy.

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