Improving the competitiveness of Russian industry in the production of measuring and analytical equipment

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Abstract: The creation of a high-tech competitive industry in the production of measuring and analytical equipment in Russia in a highly competitive environment is impossible without the development and implementation of innovative products. The vast majority of Russian enterprises invest their funds in the purchase of imported innovations instead of investing in creation of their own R & d/D (Research, Development and Engineering). Such path of development of Russian enterprises is seems to be a dead end. One can observe a growing trend in the share of R & d/D expenditures on the global market. Nowadays the leading countries of the world industry such as the United States, China, Japan and Germany invest much bigger than over countries/ invest in science more than over countries. Large-scale development and innovation implementation can be realised under creation of the system based on interconnected elements "industry-innovation-science-education". Expansion and intensification of fundamental and applied research, improvement quality of teaching mathematics, physics and engineering disciplines in higher and secondary educational institutions are seemed to be necessary/ seem to lead to better results. Large industrial Russian companies, leaders in certain sectors of industry with a powerful modern production infrastructure and huge financial capacity should act as a driving motive of the mentioned system. The state should provide support by means of legislative activity aimed to create an industrial and innovation policy providing production of innovative items which will be able to compete in high-tech segments of the world market.

1. Introduction

Development of Russian industry and all its sectors without any exception in the modern world economy cannot be implemented without innovation development. Introduction of different innovations for industrial enterprises is one of the methods to increase their competitiveness on the domestic and global markets. Economic growth in modern conditions is associated with application of innovations, the specified circumstance confirmed by numerous studies [1, 2, 3]. In the twentieth century production growth by 80-85% was explained by increasing in total productivity of production factors, while all types of innovation (technological, organizational, financial and institutional) played a key role [4]. Development of innovations in the field of applied research and its implementation in the work of industrial enterprises provides growth of labor productivity while effect depends on national economy state / but the results depends on national economy condition as a whole.
At the beginning of the twentieth century Russian science was excelled at fundamental mathematical scientists training, had close connection with the educational system and was interested in applied sciences considered as a reliable source for development of basic science. The engineering school and engineering education system in Russia based on the idea of fundamental and applied research unity have made a significant contribution to construction of technical environment which is used by humanity today. The concept of a general designer of a complicated technical system formed within the framework of the Russian engineering school and based on the principle of scientific, technical and organizational unity both in design and implementation/during design and implementation of a complicated system is one of the most important components of this contribution. Thousands of highly educated people left Russia after the Russian revolution of October 1917 including about 3,000 certified engineers who made a significant contribution to development of high-tech industries in Europe and the United States. For example, Russian designers, engineers, production organizers and inventors influenced significantly the development of aircraft construction in the United States, including A.M. Nikolsky and N. I. Sikorsky, A. A. Seversky and others. Working for Westinghouse Electric Corporation S. P. Timoshenko created the school of engineers similar to existed in pre-revolutionary Russia.

Approximately 100 thousand scientists and highly qualified specialists have emigrated from Russia to the world labor market since the beginning of the XXI century according to official data given by Federal State Statistic Service. According to various estimates the number of Russians working abroad without permanent residence registration and who have retained retaining Russian citizenship is 3-5 times higher. It means that educational and scientific base, a set of practical skills and competence of these specialists were was very much in demand and allowed them to adapt successfully in the developed market economies of Western Europe and the United States.

2. Materials and methods

After perestroika (90-ies of the XX century) industrial, innovative, scientific and educational policy of Russia was based on the concept which main principle consisted in giving up was to cease a strong relationship between the elements of the system: industry-innovation-science-education. A concept of building market economy in Russia in the twenty-first century is based on a liberal approach. The approach is based on application of the global market mechanism and creation of national development institutions as the main tools to integrate Russia's national industry into the global system of differentiation of labor formed by the leading countries of global economy. At the same time neither a level of income and unemployment of the population nor a level of dominance of national companies in the world market were chosen as the criterion of success for the national economy but product competitiveness of the separate companies including industrial enterprises, scientific and educational institutions turned out to be such criterion. Industry, innovation, science and education in Russia are not no longer considered as a whole interconnected national complex, but as a set of completely separate organizations in the field of industry, science and education, even the secondary educational institutions (schools, colleges, lyceums) have to survive on their own in the current economic situation. One can say that the main goal of market economy implemented in Russia is to create conditions for competitiveness growth on the global market for products of the separate organizations rather than predominance of the national complex “industry – innovation - science - education”.

There is a tendency on the world market to increase a share of expenditures on R & D (Research, Development and Engineering). If total level of the expenditures in 2000 on R & D in the world amounted for 1.5% of world GDP, in 2016 when a significant increase in gross output was marked it reached 1.7% of world GDP. Due to increased competition between countries in the world markets of different types products share of investment in development and implementation of innovations in the world economy is constantly increasing. For example, advanced economies increased a share of investment in science from 2.2% in 2000 to 2.5% in 2016. As for developing countries the figure has almost doubled over the same period from 0.7% to 1.2% of GDP, but one should note that China has played a key role in the process. According to UNESCO R & D investment in the world has exceeded these figures. Indeed, 1.7% of global GDP in 2016 at current prices amounted for $ 1.9 trillion. In
particular, in the United States the value is equal to $ 511.1 billion, in China - $ 451.9 billion, in Russia - $ 37.3 billion. The largest volume of investment in R & D as a percentage of country's GDP for 2000-2016 was registered in the Republic of Korea (+2.0 p.p.) and China (+1.2 p. p.). Due to effective support provided by state power/ the governments of the Republic of Korea and China for development of their own innovations world tendency was able/could maintain positive growth rates in expenditure on science and innovation over entire the seventeen-year period [Table 1].

Necessity of transformation in the field of R & D and long-playing lack of science funding in the 1990s are among the main issues in the field of innovation development in Russia. Science has survived but suffered huge losses due to the transition crisis in 1990-1998 when country's GDP fell by almost 43%. After this period Russia still keeps a relatively low level of R & D spending. In particular, in 2016 R & D expenditures in Russia amounted to only to 1.1% of GDP what is similarly to the level of 2000. As for R & D expenditures Russia takes only the fortieth place in the world ranking despite being one of the world's leading countries in terms of researchers number per capita. Generally, Russian business just starts to organize a process of its shifting to purposeful work on developing its own innovations. Only the large companies and enterprises of a fuel and energy complex of the country the majority of which provide an active R & D policy and have there/their own research units are an exception [5]. According to a/the study by the Higher school of Economics, percentage of Russian companies that implement/ implemented technological innovations and acquire/ acquired new technologies outside of Russia in 2016 was 35.7%, and in 2006-30.2%. Large-scale import of innovative technologies and emergence of new opportunities for technical re-equipment were inevitable. Many Russian industrial companies prefer to import innovations as the process involves fewer risks than creation and implementation of their own developments [6,7]. Large industrial high-tech companies invest in purchase of existing technologies instead of investing in creation of their own R & D.

| Country                | Total, billion dollars, in current prices | Share, % of GDP | Change in share p.p |
|------------------------|------------------------------------------|----------------|-------------------|
|                        | 2016  | 2000  | 2008  | 2016  | 2008-2016 | 2016  | 2008-2016 |
| Russia                 | 37.3  | 1.1   | 1.0   | 1.1   | 0.1     | 1.1   | 0.1       |
| Brazil                 | 41.1  | 1.0   | 1.1   | 1.3   | 0.2     | 1.3   | 0.2       |
| India                  | 50.1  | 0.8   | 0.9   | 0.6   | 0.3     | 0.6   | 0.3       |
| China                  | 451.9 | 0.9   | 1.4   | 2.1   | 0.7     | 2.1   | 0.7       |
| South Africa           | 5.8   | -     | 0.9   | 0.8   | 0.1     | 0.8   | 0.1       |
| Great Britain          | 47.8  | 1.6   | 1.6   | 1.7   | 0.1     | 1.7   | 0.1       |
| Germany                | 118.8 | 2.4   | 2.6   | 2.9   | 0.3     | 2.9   | 0.3       |
| Italy                  | 29.9  | 1.0   | 1.2   | 2.9   | 0.3     | 2.9   | 0.3       |
| Canada                 | 25.7  | 1.9   | 1.2   | 1.3   | 0.1     | 1.3   | 0.1       |
| US                     | 511.1 | 2.6   | 1.9   | 1.6   | 0.3     | 1.6   | 0.3       |
| France                 | 62.4  | 2.1   | 2.1   | 2.2   | 0.1     | 2.2   | 0.1       |
| Japan                  | 165.7 | 2.9   | 3.3   | 3.1   | 0.2     | 3.1   | 0.2       |
| Republic of Korea      | 77.7  | 2.2   | 3.1   | 4.2   | 1.1     | 4.2   | 1.1       |
| Spain                  | 20.1  | 0.9   | 1.3   | 1.2   | 0.1     | 1.2   | 0.1       |
| Turkey                 | 16.6  | 0.5   | 0.7   | 0.9   | 0.2     | 0.9   | 0.2       |

The factor above seemed/seems to be one of the main reasons affecting negatively on development of the system "industry-innovation-science-education" and besides it slows down the production of national innovative products.

Principle/ Philosophy of survival of a separate organization including industrial enterprises in different sectors of the economy is prevailing/prevails in Russia in the XXI century. Interests of such separate companies inevitably conflict with the national interests of the country's economy and society.
as a whole. Competitiveness of products can be achieved primarily by rising final products prices, job cuts and loss of wages, lack of investment in fixed assets, etc. Integration of small Russian industrial and scientific companies in relation to the world leaders into ready-made system of international economic relations leads to implementation of a bitten apple strategy when the main results of innovation such as sales proceeds from mass production of high-tech products and all non-material assets locate outside Russian economy [8,9]. If one applies such strategy to develop economic relations, the higher education system should mainly qualify specialists whose competence will include only application of ready-made innovative products. Deliberate reduction in volume and quality of training in mathematics, physics and other natural science subjects in secondary schools and higher education institutions in recent years might evidence it [10].

3. Research on innovations development in Russian industry

Currently and in the future creation of competitive mass-produced high-tech products on the global market such as tablets, Smartphones, consumer electronics, personal computers, medicines and automobiles requires continuous increase in complexity and volume of knowledge generated by innovations in an industry [11,12]. Expansion and intensification of fundamental and applied research, improvement quality of teaching mathematics, physics and engineering disciplines in higher and secondary educational institutions are seemed/are supposed to be necessary for better results. In the medium term ever-expanding globalization of the world economy will continue to increase growth, volume and complexity of innovations that/which are necessary to ensure competitiveness of Russian high-tech products on the world market. Large industrial Russian companies such as LUKOIL, Surgutneftegas, Nornickel, Ural Mining Metallurgical Company (UMMC), SIBUR, T Plus Group, SUEK and similar companies which are leaders in the certain sectors of the economy with powerful modern production infrastructure and huge financial opportunities should act as a driving power to implement the model "industry – innovation – science - education". They make economically feasible for large, medium and small businesses investment of means/funds in innovation creation, generate demand for results of innovation activities produced by developing small and medium-sized businesses and demand for venture capital. Also they create a/the system of international division of labor based on economic schemes such as outsourcing and risk sharing [13,14]. One of the main issues of innovative development of the national economy is not so much a solution of tactical tasks aimed to create the tools such as development institutions (economic zones, investment and venture funds, etc.) and legal framework but shortage of modern subjects being influenced/that are influenced by these tools and laws in the face of large industrial Russian high-tech system-forming companies.

Only such companies with the significant potential (investment, technological, infrastructural and organizational) are able to ensure creation and implementation of innovations because of the financial flows received from sale of the serial and mass-produced high-tech products on the world market and above all on its national part-the domestic market [15,16]. The major/biggest Russian industrial companies, leaders in their sectors, should be fully supported (financially, politically, organizationally, etc.) by both legislative and executive authorities of the Russian Federation. Being competitive in the world market such companies should provide stable employment and high level of population income, increase of tax revenues and their own profit and also profit of interrelated small and medium businesses [17]. Taking into account the world experience of high-tech and industrially developed countries, Russia’s innovation and industrial policy in the long term (30-35 years) should concentrate on/ be aimed at creating and supporting for/of the high - tech national system “industry - innovation - science-education” focused on large-scale product production of the largest Russian industrial companies. The leading companies in such priority sectors as military industrial complex, hydrocarbon and nuclear power, aircraft, shipbuilding, mechanical engineering in the next 5-10 years should solve such tasks as design and implementation of innovative products, creation of competitive end products on the global
market (nuclear power plants, missile systems, tanks, aircraft, ships, etc.) and increasing their share in the world market. To develop and implement innovations in manufacture of such products one should use ubiquitous information and telecommunication technologies with high-performance computational capabilities. It will allow to use a more flexible approach to serial and mass production of the high-tech products what will provide a possibility of rapid changes in a technological cycle to meet requirements of a particular buyer [18]. According to the authors ubiquitous information and telecommunication technologies will become the most important tool for successful competition on the world market of the XXI century. That is why industrial and innovative policy of Russia shall provide establishment of national backbone companies, leaders in their sectors, which are able to develop the technologies to the level required to meet the needs of companies that are a basis of the system "industry - innovation – science - education".

4. Conclusion
Large-scale development and innovation implementation can be realised under creation of the system based on interconnected elements "industry-innovation-science-education". The system should focus on production of the high-tech products in demand on the world market produced by large national companies which will develop and use in their work information and telecommunications technologies. Long-term effective development of each element of the system and their close, continuous relationship are seemed to be required to reach the goal. Top-quality training in mathematics, physics and other natural science subjects in secondary and higher educational institutions should form foundation of the system. The state should provide necessary support for implementation of targeted projects in such priority areas of the economy as information and telecommunications technologies, mechanical engineering and energy sector. The projects should become the main element of Russia's long-term industrial and innovation policy as they should ensure Russia's long-term economic competitiveness on the world market. The state should provide support by means of legislative activity to form industrial and innovation policy leading to creation of innovative products that will be competitive in high-tech segments of the world market. Legislation should be aimed to increase efficiency of the system "industry – innovation – science – education" which will be driving motive of Russian economy in long term perspective. To create national competitive enterprises on the world market action framework/ the system of measures (investment, legal, organizational) should be developed to ensure high-tech re-equipment of large companies in the most important industries of the national economy such as mining and oil refining industry, metallurgy, mechanical engineering and electric power industry.

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