

CURRENT STATUS AND PROBLEMS OF COMMERCIALIZATION OF INNOVATIONS IN ROBOTIC TECHNOLOGY

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Abstract: *The article discusses theoretical and practical issues of the robotics market, investigated the socio-economic conditions and the efficiency of development of the robotics market. Methodical aspects of development of the robotics market in current conditions of innovation, identified priorities for the development of the robotics market, tendencies and perspective directions of development of various branches of robotics in current conditions. The main factors contributing to the development of robotics in the coming years, trends and future directions of development of the various branches of robotics in current conditions, the improvement of commercially available key technologies, such as computer vision, speech recognition and navigation. The basic problems of the development of robotics market that determine the complexity of the application of scientific and technical problems and immaturity of the necessary basic technologies were identified and formulated. It determined the modern role of the state in the development of robotics in most industrialized countries.*

Keywords: *innovation, robotics, commercialization of innovative projects. JEL Classifications: O31, O32*

1. INTRODUCTION

In 2005, the Russian government set a goal to develop the innovation system of the country. It refers to the formation of economic conditions for bringing to market competitive, innovative products to implement strategic national

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priorities of the Russian Federation (The Main directions of policy of the Russian Federation in the field of development of innovation system for the period till 2010 (approved by the. Government of the Russian Federation dated August 5, 2005 N 2473p-P7)). And one of the priorities of the state policy in the field of innovation development was the creation of a supporting system to commercialize the results of the intellectual activity.

The attention of the state to the processes of commercialization of innovation is obvious, because currently entrepreneurs are practically immune to innovation. It confirms the following facts: investments not allocated for development, it is poorly implemented innovative technologies.

Historically, foreign companies are looking with interest at developments of Russian scientists and to the success of their commercialization. In Russia, the primary issue is the weak level of communication between scientists and business, the lack of binding between them (Prokina 2011).

In Russia, as before, when creating innovations, there remains the orientation of development of science and technology without considering the real demand. At the initial stage of development traditional market institutions support innovative activities: the number of active business angels and venture capital funds are at a low level and lagging behind that of countries that occupy the first place in the key ratings of innovative development (Shichkina, 2010). Also there are difficulties with commercial evaluation of new technologies, there are no schemes for commercialization of innovation, there are difficulties with the creation of an infrastructure for realization of innovative projects.

2. METHODOLOGY

The study used review and systematization of international experience, analysis of the industrial robotics market, identifying industry-specific robotics market as a socio-economic sector of the economy.

The methodological basis of the study was causal analysis, system approach, innovation theory, logical-mathematical modeling. The theoretical basis is made up of the works by leading Russian and foreign researchers and specialists in robotics.

As a result of the systematization and analysis of the material it is revealed that the necessary substantiation of forms and methods of formation of the market of industrial robotics with a focus on innovative development. Despite objective difficulties in the development of robotics in Russia and the narrowness of the domestic market, this sector deserves attention and active state support. In the

medium term the level of development of robotics will have a significant impact on defense capabilities and productivity in key sectors-consumers. The solution of these problems requires a comprehensive development of robotics, including the provision of training, developing related technologies and production complexes.

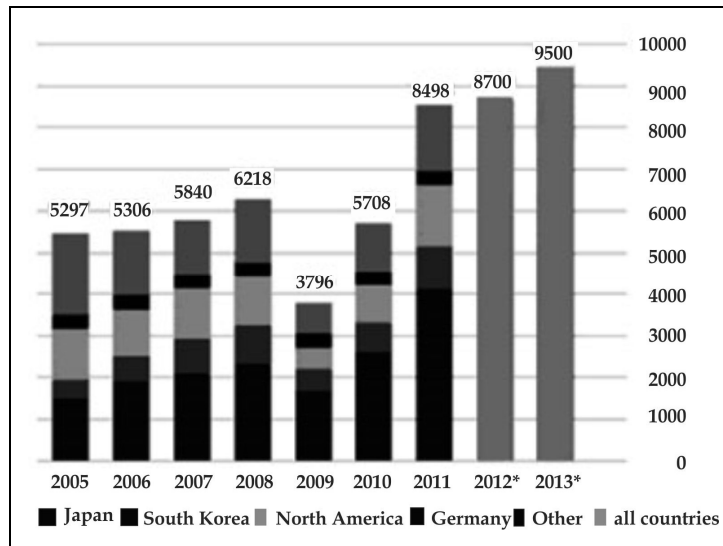
The literature review presented the opportunity to learn the most studied areas and to identify the problems in the field of industrial robotics. The main aim is to find effective mechanisms of realization of the relationship between science and business.

Great attention is paid to issues that are under scientific debate, many of them have already been explored.

The market for industrial robotics has emerged over 50 years ago. However, it continues growth with an average growth of 8.4% per year in monetary terms. Like other capital goods markets, the segment of the industrial robotics is largely influenced by economic cycles. During the crisis in 2009, the demand for industrial robots grew to almost 50%. However, in 2011-2013 the volume of the market was back to the previous indicators (Figure 1).

According to the report, "Industrial robots in the world and the Chinese automotive industry" the market volume of industrial robots in 2013 rose to 9.5 billion U.S. dollars. The average price of one new industrial robot without services integration is about 55 thousand dollars.

Figure 1: Sales volume of industrial robots in the world million U.S. dollars



The international Federation of robotics represents another assessment of the market. So, it also takes into account the cost of software, peripherals and services system organization. It constitutes 2/3 of the final cost of the project

for a customer. Therefore, the total volume of the market of industrial robotics and related services was more than 29 billion U.S. dollars in 2013.

The main sectors of application of industrial robots are the automotive industry and production of the automotive components. In terms of potential sales growth the important sectors are metallurgy and mechanical engineering, food industry, pharmaceuticals and electronics (table 1).

Table 1.
Sales of industrial robots by industry

<i>Sales of industrial robots by industry</i>	
<i>Industry</i>	<i>Sales</i>
Automotive	59705
Electronics and electrical engineering	37751
Metallurgy and mechanical engineering	14125
Chemical industry	11825
Production of glass and ceramics	828
Education and R & D	699
Paper industry	484
Food	465
Woodworking	297
Construction	256
Light industry	213
Agriculture	133
Housing and utilities	40
Mining	20
Other industry	35002
Total world consumption	166028

Among the countries that use robots in the automotive industry, Japan is leading - 1,400 robots per 10,000 workers in the sector, followed by Italy, Germany and the United States - from 1,100 to 1,200 robots per 10,000 workers.

The most popular applications of industrial robots in manufacturing are: transfer of cargo (40% of robots), welding (28% robots) and work in clean rooms (14% of the robots). The other robots are engaged in assembling, coating, machining, etc. Economic crises are forcing producers to upgrade production, expanding the range

of products using new materials and technologies (Grigoriev, Andreev and Ivanovski 2013).

Experts are quite optimistic about the future prospects of development of the industrial robotics market. There are various forecasts of the industry (Bureau of labor statistics United States). In particular, the research company Markets and Markets suggests that by 2017 the market will reach a volume of 32.8 billion U.S. dollars with an average growth rate of 5% in the period from 2012 to 2017. According to another American research company Allied Market Research (Malani 2014) the annual growth of the industrial robotics market will reach 5.4% and by 2020 will reach 41.2 billion US dollars. When considering these projections it is necessary to remember that the industry is cyclical in nature. It makes possible only a rough estimate of the trend, while the real level of sales of industrial robotics may differ significantly from those projected (Petrychenko, Saraev, Okhapkin, Tokarskaya, Abdurakhimova, Badikova, et al. 2014).

The second major group of robotics is service robots. The service robots are classified into personal service robots (Business-to-Consumer, B2C) and professional service robots (Business-to-Business, B2B, and Business-to-Government, B2G).

Service robots have formed a market in the early 1990-s. The main difference of the market of service robots from industrial is a lower level of consolidation. This is due to the presence of a large number of segments, each of which requires specific competencies. The global market for service robots has a different rating. According to the International Federation of Robotics (IFR) market volume is estimated at more than 5.3 billion U.S. dollars in 2013. At the same time, according to the company "Markets and Markets", the market volume in 2011 amounted to 17.6 billion U.S. dollars. Such significant differences in the estimation are due to the fact that the IFR does not take into account the costs of research, software implementation and system integration of robotic devices. In addition, the IFR does not include statistics on military expenditures, which constitute a significant part of the market of service robots. Based on the research of company "Global Industry Analysis" segment of military robots in 2012 was 5.6 billion US dollars. The projected growth of this segment by 2018 could reach 8.5 billion dollars U.S.

In physical terms the segment of professional service robots has increased from 20,2 thousand units in 2012 to 21 thousand in 2013. More than 9.5 thousand of them are military robots (IFR, 2014). Most popular military robot is the unmanned aerial vehicle (UAV). The sale of this device for the year increased by 8% and amounted to

8.5 million units. However, we should not forget that information about the volume of the market for military robotics is not fully opened, so the real market volumes may differ from the statements mentioned above.

Analyzing the market for professional service robots in terms of value, it would appear that the leader is robotics used in medicine. These include robotic surgical systems, devices for radiation therapy and devices for the rehabilitation of patients. Worldwide net sales amounted to 1.45 billion dollars (41% of the total market) (IFR, 2014). Medical robotics is the most expensive: the initial price of the robot is 1.5 million USD and could reach 2.3 million dollars.

In addition to the facts mentioned above military and medical robots attract the attention of agricultural, and logistics robots. The most popular of the agricultural robots are automated systems. Robots for cleaning and feeding also take a significant part another actively developing area is logistics robotics. The growth in quantitative terms, in 2013 compared to 2012 was 37% (in 2013 it sold almost 1.9 thousand logistic robots). In this segment, as in military robotics, the actual market can differ from the declared. This is due to the large number of market participants and, as a consequence, the difficulty of the calculations.

Leaders in the production of service robots are the U.S., Western Europe and Japan. Valery Komissarova, the director of development of the venture Fund "Grishin Robotics" (Grishin Robotics), gives the following specific characteristics of markets for consumer service robotics: "in the United States, a country of victorious marketing, people are able to think from the point of view of the consumer and use technology from this point of view. China has been and remains a manufacturing center, the center of the large-scale copying. While there is a very strong policy of the state trying to build its innovative economy. There are very good universities in South Korea and Japan and, as a consequence, research and development, but there are some problems with the commercialization of the product. There is a strong robotics industry in Europe, and as for service - it is at the stage of development; there are hubs in Berlin and London, but for the quality of infrastructure they are weaker than "Silicon valley".

The development of service robotics is the combination of two groups of factors. The first group of factors affects supply: the development of key technologies, cheaper components, as well as new ideas for products. The development of key technologies is possible thanks to scientific progress, which makes feasible new projects in the field of robotics. So, in mid-2000s there was a breakthrough in systems of Autonomous navigation, which led to the creation of

automatically piloted vehicles and drones. Cheaper components are associated, primarily, with the growth of production of components that increases the supply and thus lowers the cost of production. In addition, you should notice the impact of 3D printing on the process of production. 3D printing has the potential to change the production process itself. Naturally, all these reduce the cost of manufacturing of the robots, making them more commercially available. Ultimately, this will lead to the increasing of the competition as barriers to entry into the robotics market are gradually reduced. The emergence of new ideas of products associated with the development of technology and reduction in price of components.

Venture capital investments are considered the main source of development of innovative projects. Along with this, the industry of venture financing has its own characteristics that cannot be ignored. In recent years in Silicon Valley there has been a trend where the most popular projects related to software development, mobile applications, and projects on the Internet (including numerous social networking). This trend influenced the investors of the projects from other areas. So, projects in the field of robotics are considered as a non-profit, long-term, problematic in terms of the scale and distribution of the products, which naturally repels investors. However, in recent years investors are exempt from such stereotypes and begin to invest into robotic projects. The fact that giants such as «Google» and «Samsung» notice new ways of development through robotics and buy the most promising startups plays the important role. In early January 2014, Google purchased the robotics startup "Nest", a producer of thermostats and smoke detectors, for 3.2 billion dollars (Pegarov 2014). This fact, on the one hand, improves the work of the promotional developers and their products, and on the other hand, will show to investors that robotics can and should be invested.

Venture capital financing is not the only source for startups. There is a suggestion that the solution to the problem of money for small groups who have not received financial support from venture capital funds, can become a crowdfunding platform.

According to the statement of Robert Hale, the cost of stay of one soldier in Afghanistan during the year is 850 thousand US dollars (Yarynich 2010). It does not include the cost of training, the damage to the economy in the event of his death, as well as pressure from voters on politicians in connection with war losses. Considering the average costs, partial replacement of personnel on robotic devices becomes justified not only politically, but also economically.

For household robots the determining factor for the development is the growth of economic welfare of households, as well as the desire to improve the quality and security of life. For the industry of medical robots the most important factor is the aging of the population and rising costs of caring for the disabled. This problem is particularly acute in Japan, but also in other developed countries, it is becoming increasingly important (OECD, 2016).

Studying of the experience of leaders of the service robotics market is showing that their leading positions were DOS Tignale due to the rapid conclusion of the innovation to the mass market. In recent times market for robotic products is reduced (Yarotskaya and Krivoruchko 2013). So the strategic advantage of getting an experienced team who are working on new products and have access to the infrastructure of rapid prototyping, start the production and bring the product to market. The dynamics of the market of robotics service in the next decade will largely depend on progress in the development and in the demand in robotics technology.

If we consider robotics as a whole, without segmentation in industry and services, it is important to note the fact that robotics is moving into a new phase of dynamic growth now. Improving component base and software allow it to make a qualitative leap, at the same time create many new niches. The main factors that contribute to the development of robotics in future will be reducing the cost of components of robotic devices, and improvement of technologies such as computer vision, speech recognition, navigation (YCombinator).

The main problems of the development of robotics are the complexity of applied scientific-technical problems, the immaturity of the necessary underlying technologies. Therefore, the state plays a key role in the development of robotics in most industrialized countries. USA and several countries in Europe have managed to achieve significant results in this matter.

4. DISCUSSION

As a result of generalization, analysis and systematization of theoretical and analytical information on the development of robotics industries we were able to confirm the hypothesis about the need for their commercialization, which would take into account possible priorities and a Toolkit describing the regularities of formation and distribution of robotic potential for cost-

effective implementation of technologies on an industrial scale. A distinctive feature of this research is the attempt to focus on the specifics of commercialization of scientific and technical activities results, which is the process of turning these results into the goods and their efficient implementation on an industrial scale. In the study of the analytical issues and practical problems were identified and discussed features of commercialization in the sectors of robotics, as an important element of the process of innovation.

5. CONCLUSION

The involvement of Russia in starting the boom of robotics is clearly not traced. Speaking about the Russian market of civil robotics, its volume is insignificant. In addition, our manufacturers are forced to compete in the domestic market with international companies. The limited domestic demand and complexity of entering foreign markets don't allow domestic companies to use economies of scale. Small experience in the development, promotion and sales of civilian robotics do not allow compete in quality of products and level of service supported by Western colleagues. High costs of the organizing of production: a significant tax burden, the cost of resources, components and debt financing, as well as low productivity reduce the competitiveness of Russian products in price.

From an economic point of view these barriers, including problems of the organization of production, to date, are serious obstacles for the domestic industrial robotics. The Russian service robotics loses in terms of industrial design and marketing. However, relatively competitive area is special purpose robotics, but its manufacturers do not show visible activity in the commercialization of their developments, based on the state order. As a result of strong dependence-a relationship from key customers and problems with financing are the limiting factors for the development of robotics special purpose.

Thus, in Russia there are potentially promising areas for the development. First of all, the segments with significant domestic demand: military and special robotics, mining, infrastructure, logistics and health care. With the support from the Russian state it has the opportunity to the significant increase of the share on the global market for robotic products through successful projects in these segments.

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