Problems and Prospects of the New Industrialization of the Russian Economy Under the Transition to the Sixth Technological Mode

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Abstract. Purpose: The article discusses the problems and prospects of the new industrialization of the Russian economy in the global competitive environment.

Design/Methodology/Approach: The authors present the distinction between the processes of re-industrialization and new industrialization. The authors have defined the features of new industrialization in the transition to the sixth technological mode, which reflect the emergence of new industries on the basis of new technologies, primarily nanotechnology, information technology, the artificial intelligence creation and biotechnology. At the same time, the transition to a new technological mode leads to the effect of new technologies "diffusion", which makes it possible to modernize traditional industries on a new technological platform.

Findings: The authors disclose the impact of the new industrialization processes on improving the global competitiveness of Russian economy in modern conditions. They also consider the problem of the occurrence of double transformation and transaction costs under the transition to a new technology and determine the ways to overcome them in the investment cycle.

Originality/Value: The article reveals the possibilities and the existing systemic limitations of developing new industrialization processes in the industry structure of the Russian economy. It proves the necessity of using the systemic multi-level approach to implementing the concept of new industrialization. It substantiates the leading role in forming the new technological mode of large integrated structures that have a high innovative and investment development potential and can become full-fledged participants in the global competitive relations.

Keywords: New industrialization · Competitiveness · New technologies · Technological mode · Nanotechnology · Integration of production · Large integrated companies

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1 Introduction

The development of new industrialization processes in the modern Russian economy contributes to the growth of its competitiveness on a global scale. At the same time, the new industrialization processes are fundamentally different from the re-industrialization processes, which involve the restoration of industrial production based on the traditionally existing fourth and fifth technological modes. New industrialization proposes to focus on developing fundamentally new types of industrial production.

In present conditions, new industrialization should involve the transition to the new sixth technological mode, within which nanotechnologies and nanomaterials, digital technologies and robotization, artificial intelligence, biotechnologies and bioengineering, etc. could be applied to a wide range of industries all over the world. The development of these modern technologies in the Russian Federation is lagging behind the world leaders that prevent the country from occupying the leading position in the global competition. In particular, according to the World Economic Forum Report "The Future of Jobs Report 2018", if per 10,000 workers in South Korea there are 631 newly introduced robots, in Japan there are 303 ones, in Germany there are 309 ones, but in Russia there are only 3 robots (The Future of Jobs Report 2018).

The way to change the situation is to implement a consistent policy of large-scale new industrialization, which, in turn, should be based on industrial integration in particular. Indeed, the provision of favorable structural conditions for the creation, distribution and diffusion of innovative technologies is connected with the development of vertically integrated industrial companies, which should act as the fulcrum in the system of global competitive relations.

Such a structure allows for the possibility of achieving integration processes of the new types of goods and services development and industrial application. This in turn would generate synergistic and scale effects due to reducing transformation and transaction costs and synchronizing investment processes, which are aimed at modernizing the existing production along the entire value-adding chain.

In addition, the vertical integration of large industrial companies allows using the system of transfer pricing and cross interest rate subsidies on foreign loans. In general, international experience shows that large integrated companies nowadays combine production, research, logistics, financial, transport and information departments in a structural way.

Of course, within the framework of the new industrialization concept, the significant part is also assigned to small innovative enterprises and venture funds, without which the implementation of a number of innovative projects would be impossible (Mochalova and Petergova 2015). At the same time, the significant innovation potential is still associated with the large companies, the integrated companies in particular, because any modern high-tech product involves successive stages in the integral production process organization. In order to optimize logistics, temporary losses, and to ensure comparable quality standards at each production stage, integration becomes an important condition for the systemic nature of the new industrialization processes of the modern Russian economy.

2 Materials and Method

The authors made use of publicly available materials for the research including scientific monographs, classical works on the innovative development economics, and scientific articles on the topic by leading domestic and foreign scientists. Statistical data were utilized to analyze the dynamics of transformational processes in industry as a part of implementing the new industrialization concept. The World Economic Forum Report "The Future of Jobs Report" and other documents reflecting the transition to a new technological mode have been used in the paper.

In the paper, the authors have applied general scientific research methods of induction and deduction, analysis and synthesis, dialectics, hypothetico-deductive method. The methods of comparative analysis of various economic systems and methods of analogies, as well as historical and evolutionary analysis have also been employed. The use of system's analysis methods when considering transition to the new technological mode, the analysis of new technological platforms, as well as the method of systems science process was of great importance in the article.

3 Results

In fact, it is necessary to pay attention to the deficiency of the systemic nature of the new industrialization process in modern Russia. Narrow localization and limited innovations do not give the expected result, even in such advanced technologies as nanotechnology, for example. It is worth noting that not all new nanotechnology products find further application in the domestic industry (Table 1).

Table 1. Perspective areas for nanotechnology development in Russia

№	Nanotechnology products	Field of use
1.	Chemically selective nanostructured membranes for separating homogeneous catalysis products from a catalytic converter	Chemical industry, production of alcohols, aldehydes, plasticizers for polymers
2.	Polysilicone, graphene, aerographene, silicene, nanocrystals	Electronic industry, professional equipment, machinery-producing industry
3.	Nano tubes, DNA nanotechnologies, carbon nano tubes, nanotube resonator	Health care and medicine, biotechnology, engineering
4.	Molecular rotors, nano-antennas, nano-accumulators, plasmons	Robotechnics, aircraft manufacturing, professional equipment
5.	Highly active nanostructured catalytic converters	Chemical industry, synthesis of nanostructured polyolefins

Source compiled by authors based on materials (Kireev 2018)

Many industries presented in Table 1 are not sufficiently developed in Russia nowadays. We mean, above all, professional equipment, the chemical industry, robotechnics and others. In this case, most of nanomaterials produced today are not

used in the production of the finished goods. This is due to the low degree of technological integration and the insufficient level of systemic nanotechnology development (Inshakov 2010). Many nanomaterials, polysilicon in particular, are sent to large foreign companies as an intermediate product for its further use in high-tech industrial production. In this case, the transition to a new technological mode will be fragmented.

It must also be noted that the systematic nature of the new industrialization processes and the transition to the sixth technological mode involves not only the creation of new production works and new industries, but also a large-scale process of modernizing the existing ones. In Glazyev opinion the influence of new technological structures on developing traditional industries is possible and necessary. At present moment, the so-called sixth technological mode is actively forming and it is entering its growth stage. The basis of this mode is composed of genetic engineering, artificial intelligence and computer-based education, new biomaterials, nanotechnology, which in turn covers a whole range of independent areas (nanoelectronics, nanomaterials and nanostructured coatings, molecular and nanophotonics, nanobiotechnology, nanoscale machinery and equipment, nanotubes, etc.) In addition, despite the crisis phenomena in many industries, including traditional ones, production in these areas shows a significant growth of 30–70% per year on average. Along with the new development directions related to nanotechnology, traditional industries such as aerospace, electrical engineering, nuclear industry, instrument engineering, shipbuilding, machine-tool construction, construction, communications, which can be attributed to the industries of previous technological modes, achieve positive momentum (Glazyev 2009).

At the same time, the new technological mode has a positive impact on developing health care, education and agriculture, thanks to the use of cellular technology, bioengineering, and on creating new biomaterials. The new mode increases the potential for renewal and full-scale modernization of such traditional industries as ferrous and non-ferrous metallurgy, the chemical industry, construction, aircraft and shipbuilding (Glazyev 2009). The development of such effects should be supported through forming the specific innovation infrastructure and institutional environment.

Thus, in terms of a large-scale transition to the sixth technological mode, one should take into account the need for accelerated modernization of existing traditional industries based on new technologies, which in turn may require quite a large amount of investment resources (Kurchenkov et al. 2017). In particular, it may become obvious that in traditional industries the obsolescence of the capital equipment will outrun its depreciation. It has been found out that the average depreciation age of machinery and equipment in the leading industries is 7–15 years, and its planned obsolescence is 5–7 years. This fact makes it necessary to use the mechanism of accelerated depreciation, which is aimed at obtaining certain tax benefits for large industrial corporations.

Most modern industrial companies in traditional industries are practically forced to turn to new technologies before the end of the normal term of depreciation deductions. In this regard, risks of the so-called “double costs” may naturally arise. These double costs are associated with the costs of creating and using new technology on the one hand, and with the costs of depreciating old equipment, the cost of which is not fully recovered, on the other hand. In this situation, it is necessary to obtain the additional source of investment funds that could cover these double costs. Own funds of enterprises and the industry, as a whole may not be enough for this purpose. Given that

today in most cases, many domestic industrial enterprises, carrying out modernization of production, can rely only on their own funds.

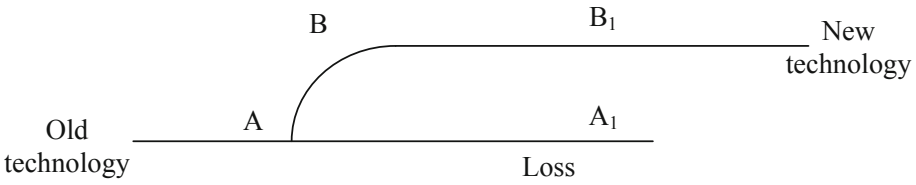

Fig. 1. The structure of investment costs in the transition to the new technological mode in traditional industries

As shown in Fig. 1, sections BB_1 and AA_1 reflect the double costs associated with the outrunning transition of an industrial enterprise to new technologies. Coverage of this amount of costs becomes possible due to the significant savings or financial reserves, which the normal profit of enterprises of traditional industries of the fourth and fifth technological modes cannot provide. Therefore, as have been noted, the possibility of an advanced process of updating production for these enterprises should consist of additional sources of financing, including external sources, venture capital funds, state investments, etc.

Here, in one sense, we can talk about the situation of the "technological gap" by Foster, according to which production costs in the conditions of using traditional technologies at a certain stage make the enterprise inefficient. There is a need to move to a new technology, or to work within the framework of a new technological mode. The enterprise that will first reach this "technological limit" and make timely efforts to turn to new technologies is able to become the leader among the enterprises of this industry. "It is extremely important for a company to recognize the technological limit in order to anticipate changes and, at least, stop investing in something that can no longer be improved …" (Foster 1987).

According to Foster, using the strategic advantage of the naturally occurring "technological gap" is possible in the context of a constant and large-scale search for innovative technologies by the "attacking" corporation. Due to it, this corporation becomes the leader in its industry, as has been noted. The implementation of this strategic concept is an important task for enterprises of traditional industries in the context of the transition to a new technological mode. However, this is possible for sufficiently large enterprises that have large investment resources to introduce new technologies and to compensate the double costs that naturally occur during the transition to a new technological mode. Indeed, the significant part of innovative technologies and products is applied in large corporate structures (Zedtwitz et al. 2016). At the same time, taking into account the structural features of large integrated groups, it should be assumed that they have the ability to carry out a closed innovation cycle from development to implementation within the same company, which can significantly increase its competitiveness on a global scale.

In addition, we should mention the ever-increasing technological complexity of the final innovative products, which involves the use of special competencies. In turn, these competencies must be consistently integrated within the framework of a single production process, which is most easily achieved within the boundaries of one integrated company.

Such integration processes are of great importance for ensuring a systematic new industrialization policy in the Russian economy, since they enable the simultaneous use of innovations at all stages of production, from the new materials development to the finished product design. The Japanese economist Kono considered a quick adaptation to technological changes through the timely correction of specializations and scale of production to be one of the advantages of the vertical integration in industry (Kono 1987). The development of the vertical integration in industry stimulates innovation activity. The increasing requirements to quality standards in production sometimes become the main motive for the integration of large corporations, which makes it possible to take control of all stages of development, production, marketing and maintenance of main products and components.

Unsuccessful examples of the vertical integration are mainly connected with the technological incompatibility of the integrated production processes, and with the lack of synergy. As Glazyev noted, synchronization of innovations implies their technological compatibility and interdependence. Only in this case they will stimulate and complement each other. Otherwise, significant scientific discoveries and inventions in one industry will not be able to find implementation in related industries until they reach the appropriate (comparable) level of innovative and technological development (Glazyev 2009).

Thus, the integration processes contribute to the acceleration of new industrialization processes in industries, and the substantial investment resources of large companies make it possible to cover investment costs associated with the transition to the sixth technological mode. The effect of new industrialization should be expected in a large-scale transition to new convergent technologies in several industries at once. It is the integrated large companies focused on the production of finished high-tech products that should become the core of this large-scale systemic new industrialization.

4 Conclusion

Thus, in the modern context, to increase the competitiveness of the Russian economy, it is necessary to intensify the new industrialization processes, which should contribute to the development of new production works and industries in such areas as nanotechnology, artificial intelligence, biotechnology, etc.

At the same time, the transition to the sixth technological mode should contribute to the renewal and modernization of traditional industries of the fourth and fifth mode. In the near future, new industrialization should become a driver of the accelerated development of a number of sectors of the national economy, which are still considered traditional nowadays. This is primarily engineering, ferrous and non-ferrous metallurgy, chemical and petrochemical. Meanwhile, the actual high-tech industries are professional equipment, nanotechnologies and nanomaterials, etc. (Inshakov et al. 2017).

It must also be noted that large integrated companies play a significant role in enhancing the new industrialization processes. At the macro level, the development of large integrated structures helps to achieve the synergistic effect from combining the research and production sectors in the single economic space. These vertically integrated companies are becoming a serious factor or a tool for competitive opposition to the foreign multinationals in the struggle for world resources and technological superiority. The experience of developed countries shows that the industrial integration on a vertical principle, which also includes research institutes and centers, is becoming an important factor in the sustainable innovative development of the national economy.

On the one hand, large integrated companies concentrate the significant investment resources, which make it possible to cover the double costs associated with the transition to a new technological mode. On the other hand, integration interaction allows overcoming the localization and fragmentation of new industrialization processes at the level of the entire industry, which makes the process more organized, consistent and systemic. Unified organizational charts are formed, and they cover both the development and mastering the production of innovative products in a single management and information field.

The implementation of the effective new industrialization policy in the Russian economy should be based on the possibility of combining all types of resources of large integrated companies, state funds and research institutes and centers. At the same time, the most important points are: the possibility of implementing strategies for pre-competitive integration of companies; creating some kind of research and development associations based on technological platforms of a new technological mode, which can be successfully used in the production of final innovative products with high value added.

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