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The Socioeconomic Development of Russia: Some Historical Aspects

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Abstract:

The study is devoted to the analysis of the socioeconomic development of Russia in the context of changing technological paradigms.

The authors determined the main theoretical characteristics of changing technological paradigms in the context of developing socioeconomic systems.

They introduce characteristics of technological paradigms, identify processes that occurred during changing technological paradigms in the world's leading countries, and present the analysis of social, technological and economic development in Russia from the late 19th century until now.

***Keywords**: Technological paradigm, technical and economic paradigm, economic growth, labor productivity.*

***JEL Classification:** O10, O14, O15.*

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1. Introduction

At present, the sixth technological paradigm is in its embryonic stage of development, where a technology pool is being formed that will underlie the fourth industrial revolution. As a result of changes that occur with the introduction of these technologies, the labor productivity will significantly increase, some structural elements of enterprise business models will change, and there will be labor migration to new rapidly growing sectors of the economy.

The National Technological Initiative started to be implemented in Russia in 2014 under these conditions, the main objective of which was to form new and strengthen existing programs to support scientific and technological development that would help shaping the branches of the new technological paradigm in the country and developing suprasectoral (cross-cutting) technologies. The importance of implementing this initiative for Russia lies in creation of the basis for the development and production of technical solutions in the country based on technologies of the sixth technological paradigm that are required for replacing the existing production capacities, more efficient organization of existing production and creation of production sites for products of the new technological order.

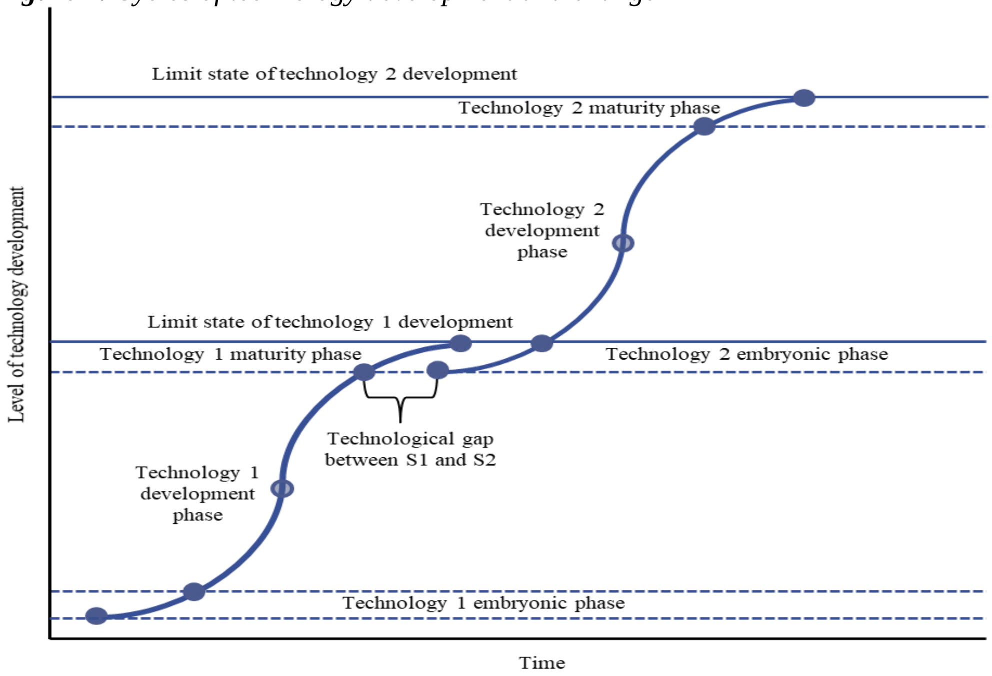
As such, the goal of this work is to study the development of Russia in the context of changing technological paradigms. To achieve this goal, the author divided the paper into three parts: the first part covers the key theoretical aspects of the development and change of technological paradigm, the second part covers the key historical aspects and characteristics of changing technological paradigms in the context of the global socioeconomic development, and the third covers analysis of Russia’s development in the framework of the technological and economic development of the social system.

2. Concerning the concept of technological paradigms and technology change in the process of socioeconomic development

According to Perez (1985; 2009) the new technological and economic paradigm develops as a result of diffusion of new technologies, which leads to their multiplicative influence on the economy, also changing the socio-institutional structures. As such, the technological and economic paradigm can be defined as a set of the most successful and profitable practices existing in the context of the need to choose primary materials, methods and technologies within organizational structures, business models and strategies. These mutually compatible principles and criteria develop as a result of using new technologies, overcoming obstacles and finding the most appropriate procedures, established practices and structures (Perez, 1985; 2009). As such, the evolutionary development of the economy, technology and techniques results in accumulation of knowledge and resources in order to accomplish technical and economic breakthrough, and also results in the launch of constructing a new socioeconomic reality.

Competition encourages companies to continue demonstrating the superior efficiency of certain methods and structures when it is necessary to achieve the highest efficiency and profit resulting from application of new technologies. The development of technologies occurs in the form of the s-shaped curve in accordance with the Rogers law (Rogers, 1995). As such, when the first technology reaches the development limit (Figure 1) in terms of reducing the cost of its use and increasing its productivity through continuous improvement, it is necessary to shift to a new technology where the development limit has not yet been reached. Realizing this shift and overcoming the technological gap between the two technologies through investment will allow the company to gain a long-term advantage over its competitors, because the result achieved by the company through using the second technology will be much higher than the result of using the first one. This results in the evolutionary development of basic industries and a change in technology in them.

Figure 1. *Cycles of technology development and change*



Emergence of the key factor (primary material), which is sold at a low cost or becomes cheaper, inexhaustible in the near future, can be applied in various fields and can lead to a reduction in the cost of capital and labor, and is one of the most important drivers for the emergence of a new technological and economic paradigm (Perez, 2009).

Figure 2. *Schematic representation of the point of shift from technology 1 to technology 2*

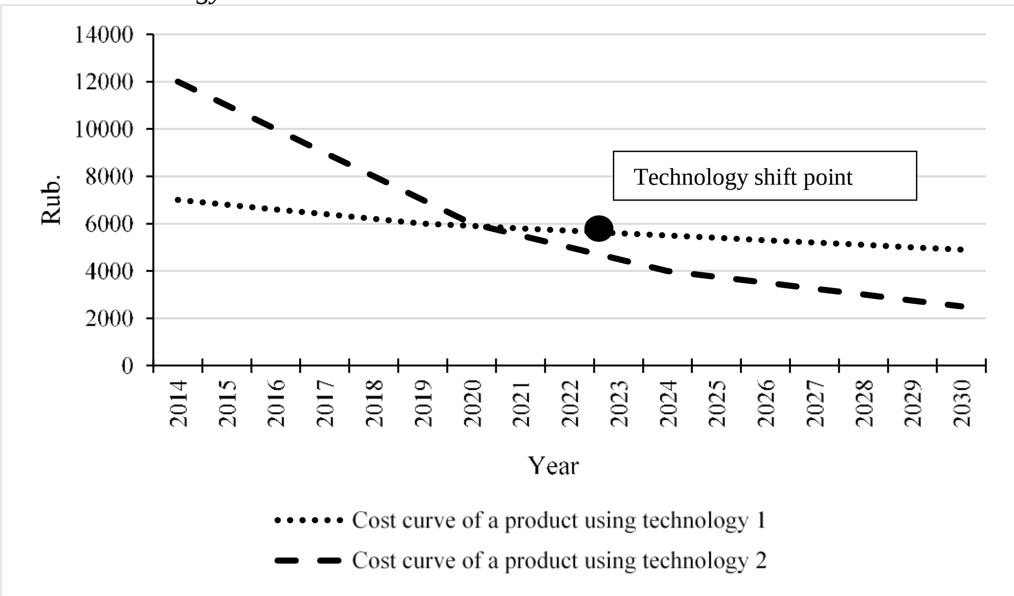
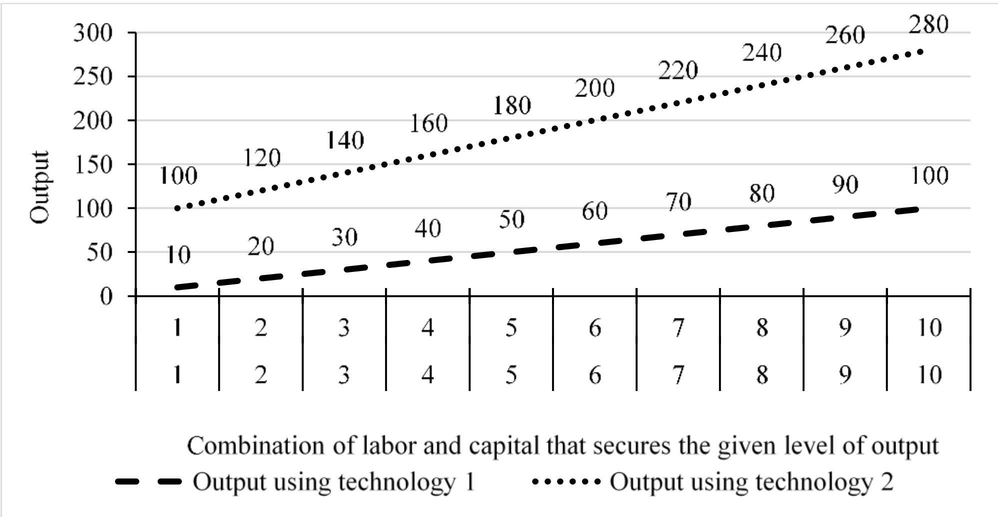


Figure 3. *Product output at a given combination of labor and capital but using various technologies*

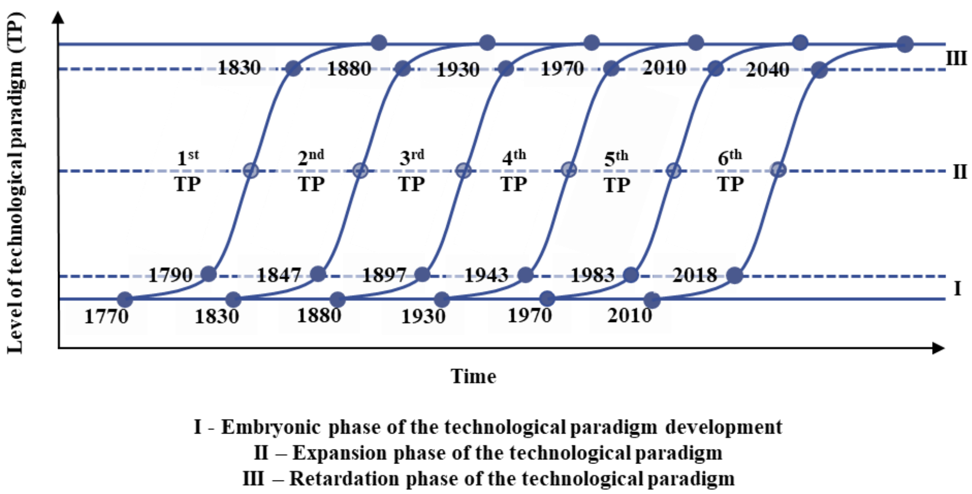


Productivity of capital and labor required for the production of one unit grows along with reduction in their cost. This process is schematically represented in Figure 2, which shows the shift from technology 1 to the new technology 2 resulting from the reduction in the cost of the product it was used for, as well as in Figure 3, which shows an example of changes in labor and capital productivity in the shift from technology 1 to technology 2.

3. Analysis of historical aspects of the global socioeconomic development in the context of changing technological paradigms

Now let's turn to consideration of the key technological paradigms identified in the academic literature. To date, the generally accepted (Coccia 2015; Glazyev *et al.*, 2009; Borovkov *et al.*, 2012) classification is the one shown in Figure 4. The dates in this figure correspond to the three stages of development for each technological paradigm: embryonic, growth and maturity. In this interpretation, the concept of technological paradigms is close to the life cycle theories. Analysis of historical aspects and characteristics of various technological paradigms is provided by the author on the basis of the classification presented below. The author's contribution to this concept is clarification of the role of human capital, purchasing power of the population and the network interaction among key market players in the development of interindustry and suprasectoral technologies within each paradigm.

Figure 4. *Changing technological modes in the course of modern economic development (Glazyev et al., 2009)*



Great Britain, France and Belgium were technological leaders in the world during the first technological mode, which dominated from 1770 to 1830. The shift to this technological mode was accomplished due to mechanization and concentration of production at factories. Development of the textile industry, textile machinery, iron smelting, iron processing, construction of canals and the invention of a steam engine were the core of the modexx. Destruction of feudal monopolies and free trade led to the development of competition between small enterprises and the institution of partnership in business. The first industrial revolution was accomplished due to mechanization of production using a steam engine, which resulted in increased productivity, creating jobs and opportunities for sustainable economic growth of the leading countries (VDI The Association of German Engineers, 2015).

Steam engines and machine building became the basis of the production contour for the shift to the second technological mode (1830-1880). The United Kingdom, France, Belgium, Germany and the United States were the technological leaders during this period. The steam engine, machine-tool construction, railway construction, machine and vessel engineering, coal and metallurgy were the core of the technological mode. Introduction of a steam engine and technological progress in metalworking set the conditions for machines' manufacturing and labor mechanization. Progress in transport engineering and the development of transport infrastructure allowed to expand cargo transportation and ensure steady supply, which in turn led to an increase in scales and concentration of production based on the use of a steam engine. At the time, the population demand was largely limited to the output of agriculture and light industry.

Creation of machine-building products, inorganic petrochemistry and electric power industry at the peak of the second technological mode predetermined the creation of more flexible basic technologies of the third technological mode (1880-1930). Germany, the United States, Britain, France, Belgium, Switzerland and the Netherlands were technological leaders in its framework. Further growth of sectoral mechanization and increase in labor productivity became possible due to electrical technologies. Electrometallurgical and electrochemical productions began to develop. Besides, replacement of the steam engine with electric at machine-building enterprises allowed to arrange more flexible production, expand the range of products and introduce flow-line technique. Development of machine-building production has stimulated the development of ferrous metallurgy and the emergence of new structural materials based on cheap steel.

Automobile and tractor building, non-ferrous metallurgy, synthetic materials, an internal combustion engine, organic chemistry and oil refining became the core of the fourth technological order (1930-1970). Technological leadership was captured by the United States, countries of Western Europe and Japan. Creation of consumer durable goods (including cars, refrigerators, radios, telephones, electrical goods, synthetic products, etc.) and building models of cheap mass production expanded human needs. Besides, there was a revolution in the method of enterprise management in those years. The revolution was based on the delineation of the functions of the owner and the manager – a highly qualified specialist with specific knowledge and creative abilities that are required for managing a complex organization in a rapidly changing world (Drucker, 2014).

Electronic industry, computer and fiber-optic equipment, software, telecommunications, robotics, gas production and processing, as well as information services became the core of the fifth technological order (1970-2010). The United

States, the EU and Japan were the world leaders in this period. Development of microelectronics, software, information and communication technologies led to the situation where industrial enterprises were able to conduct flexible labor automation and create more sophisticated customized products.

Changes in the information and communication field, emergence of antimonopoly legislation and legal establishment of various forms of partnerships, the goal of which is exchange of technologies and their development, have made it unprofitable for individual companies to develop basic technologies due to high risks and capital expenditures. As a consequence, companies began collaborating to reduce risks and costs during the uncertainty period preceding the emergence of the basic technology and the generally accepted product design (Schilling *et al.*, 2012; Hill *et al.*, 2014; Schilling, 2015). The synergetic effect obtained as a result of collective training secured by a sufficient number of innovation sources (internal and external), based on various academic and technological skills, obtained, inter alia, through deeper specialization of individual network participants, becomes the key to the successful development of a new technology (Coccia, 2015).

Shift to the sixth technological order is associated with the need for the fourth industrial revolution, which is based on a cyber-physical production system built on the model of social networks. Further development of production will be based on the merger of four major technology groups. The first group includes technologies related to accumulation of big data, the second group includes machine learning and artificial intelligence techniques and advanced data analysis, the third group includes a new generation of graphic and sensor user interfaces, virtual and augmented reality, and the fourth group includes additive production, advanced robotics, cost-effective storage and power generation (VDI The Association of German Engineers, 2015; Delloitte in Switzerland, 2015; McKinsey Digital, 2015; KPMG, 2016).

4. Analysis of historical aspects of the global socioeconomic development in the context of changing technological paradigms in Russia

Industrialization in the Russian Empire began about 40-50 years later than in the developed western countries: England, Germany, France, and the United States. The delay was associated with the system of feudal land ownership and serfdom, which lasted for a long time and hindered the development of private enterprises. The economic prerequisites for this process included: crisis of the landlord economy, poverty of peasants, low purchasing power of the population and underdevelopment of the domestic market. Besides, serfdom significantly inhibited the growth of hired labor and led to a shortage of labor for industry (Muravyeva, 2012).

Witte’s reforms significantly stimulated economic growth. In particular, extraction and production of iron, steel, coal and oil increased two to three times between 1890 and 1900, due to the establishment of higher (relative to price) tariffs for primary commodities. This contributed to the fragmented development of the basic branches of the first and second technological paradigms in the Russian Empire. Intensive construction of the railway network provided additional support to the industry, which secured demand necessary for the development of heavy industry in the Russian Empire. The length of the railway tracks was 1,254 km in 1860, 22,900 km in 1880, 53,2 thous. km in 1900 and 71.7 thous. km in 1917.

The First World War, the February and October Revolutions in 1917, the Civil War of 1917-1923 and military communism of 1918-1920 all led to the decline of the economy, depletion of human capital and widening gap in development between the developed countries and the USSR. Over 1913-1920, gross agricultural output decreased by 33%, industrial output decreased by 43%.

NEP (New Economic Policy) of 1921-1928 allowed to partially recover the economy of the country. However, later it was decided to abandon it in favor of accelerated industrialization, which was primarily accomplished within the first (1928-1934) and the second (1933-1937) five-year plans.

The goals of the first and the second five-year plans were to create new capital-intensive industries: aviation, automotive, tractor, chemical, machine-building, electrical engineering, as well as related industries, and to locate the industries in areas remote from the borders (Shpotov, 2010; Denisova *et al.*, 2017). These industries were basic for the third technological paradigm, which reached the limit of its development in Western countries back in the 1930s. Overall, the USSR made a major leap in development over the decade, becoming the world's second largest industrial power in the world after the United States by absolute figures of the industrial product output (Chevardin, 2013).

During the Great Patriotic War, most of the country's industry was involved in the production of military products. Later, right up to the collapse of the USSR, the defense industry became the main place for the concentration of the most highly qualified personnel and academic engineers. This was due to the beginning of the Cold War and the arms race between the two military and political powers led by the USSR and the United States.

In particular, about 260 restricted-access cities of science and industrial production were created across the USSR. About 80% of the research and engineering projects and developments that were carried out in several thousand specialized research institutes and nearly 900 universities were directly or indirectly aimed at military orders, although they were officially considered civilian projects (Agirrechu, 2009). 70% of the country's scientists were employed in scientific research institutes related to the defense sector (Lebedev and Lebedev, 2014).

Absorbing most of the country's intellectual and primary resources, as of the end of the 1980s, defense industry enterprises produced only 20-25% of the gross domestic product (GDP), including most of the civilian products: 90% of TV sets, refrigerators, radios, 50% of vacuum cleaners, motorcycles, electric stoves. In the aggregate, this led to an excessive increase in the number of "unproductive" expenditures on arms production to the detriment of consumption field (Bystrova, 2003; Danilina *et al.,* 2015).

As a result of the above reasons, civilian industries produced almost no demand for new professions, and higher educational institutions were engaged in reproduction of the professional structure for the industrial period and did not train personnel for the post-industrial period (the fifth economic paradigm).

As such, the administrative command system of economic management failed to establish the systematic operation within the country and develop cross-sectoral technologies. In fact, the third, fourth and fifth technological paradigms existed in the USSR simultaneously by 1990, with their branches at different stages of development. As a consequence, they struggled for limited resources (including intellectual and financial resources). Organic evolutionary development was de facto impossible due to the specifics of the economic system and the lag behind the leading countries in terms of technology level and training of personnel for the new, fifth economic paradigm.

Besides, as of 1960-1970, about ¾ of applications for an invention were duplicated due to the lack of the developed network interaction among a large number of enterprises, research institutes, design bureaus, universities and institutions of secondary vocational education. As a result, new interbranch technologies were developed, mastered and implemented much more slowly than in the leading countries (Bokarev, 2007; Rodionov et al., 2014; 2016; Kitova *et al.,* 2017).

The collapse of the USSR resulted in a deep socioeconomic crisis throughout the post-Soviet space. Destruction of the established system of the economy organization and the personnel training led to a significant aggravation of problems associated with the personnel training. On the one hand, there has been a sharp increase in demand for higher education, while on the other hand, the enterprises have overnight plunged into new economic conditions – the emerging market economy. As such, the educational system responded inertially to changes in the socioeconomic system and failed to provide the economy with the personnel necessary for the development and implementation of new technologies and principles of production organization. As some researchers note, this was one of the reasons for the current backwardness of the higher education system in Russia.

The socioeconomic crisis of the 1990s resulted in a sharp decline in both the country's GDP and labor productivity. The recovery growth of 2000-2017 appeared insufficient even for a return to the volume of the 1990s. As a result, Russia has significantly lagged behind both the most developed countries of Western Europe and the world. For example, the GDP level by 2017 (Figure 5) expressed in PPP prices for national currencies in 2000 corresponded to the level of the 1980s in

Germany, the 1990s in France, the 1970s in Japan and the 1940s in the United States, while the GDP production per employed in Russia (Figure 6) corresponded to the mid-1950s in Germany and France, the mid-1960s in Japan and the mid-1940s in the United States.

Figure 5. *Dynamics of GDP production in Russia, Germany, France, Japan and the US in the period from 1900 to 2017 in PPP (Purchasing power parity) prices for national currencies in 2000*

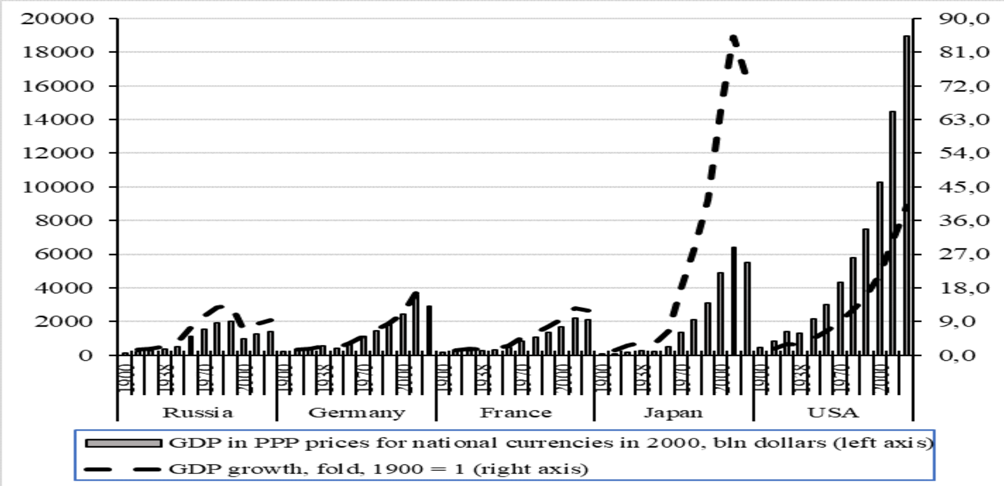


Figure 6. *Dynamics of GDP production per employed in Russia, Germany, France, Japan and the US in the period from 1900 to 2017 in PPP prices for national currencies in 2000*

By 2017, Russia lagged far behind the leading countries and countries with a high rate of development because of the deep socioeconomic crisis that followed the collapse of the USSR, the USSR's focus on developing the defense industry to the detriment of civilian sectors, low cooperation in terms of development and implementation of the new intersectoral and suprasectoral technologies. The sharp economic growth of the USSR, which was achieved at certain periods of its historical development, was due to the use of administrative command management methods, which involved the ability to concentrate labor, intellectual resources and primary materials bases on the most important area for the state.

As a result, some industries managed to make a qualitative leap in development and shift to the technologies of the new paradigm, while others didn’t. In addition, the narrowness and underdevelopment of the consumer market in the USSR in combination with the planned economy did not allow for the evolutionary development of civilian industries according to the model of Western countries. The enterprises of the former defense industrial complex had the greatest opportunities for diversification of production and rapid adaptation to the market, in view of the availability of the most advanced technical base and scientific developments in the country.

However, situation for them was sometimes more severe than for the civil industry enterprises, because of the sharp decline in the consumption of defense products in the country and the inability to use technology to produce civilian products because of their secrecy. As a result, these enterprises could not become the flagships of the domestic industry in terms of manufacturing high-tech consumer products in the context of insufficient funds to modernize production, impossibility of adapting existing technologies for civilian production and sharp market saturation with cheap imported goods and products.

5. Conclusion

In conclusion, it must be noted that Russia needs to pursue targeted policy of developing human capital and expanding the efficient demand through exports, which allows to obtain competitive advantages in the production of goods and services of a new technological paradigm. Countries that for some reason have not invested in the development of human capital and/or were colonies of developed countries have lagged in development behind the leading countries for decades. The exponential development of computer and information technologies significantly increased this gap, which led to the consolidation of the system in which most countries of the world exchange high-tech imports for primary material exports. As a result, their ability of the catch-up development is seriously limited due to the relatively low level of human capital development and the need to repeat the capital-intensive R&D process from scratch. As such, it can be concluded that the key technologies of the sixth technological paradigm will further widen the gap between the developed and developing countries, as well as the Third World countries.

The Russian Federation can join the leading countries and develop the basic industries of the sixth technological paradigm, but it needs to overcome the consequences of the USSR economic policy and the socioeconomic crisis of the 1990s described above in order to achieve this goal. For example, it requires to build an education system capable of training personnel that meets the qualification requirements for both employees and developers of the sixth technological paradigm. Exponentially growing complexity and cost of R&D will challenge companies, universities, colleges and states to increase the consolidation of their efforts to develop future technologies and bring them to the market. Along with the need for advanced personnel training, this will determine the expansion of strategic alliances and partnership programs between companies and universities in terms of both training specialists and joint research. On the other hand, some of the employee's functions will be replaced by information systems, which will reduce the need for personnel in production but create demand for personnel with interdisciplinary knowledge, for example an employee with skills in robotic systems and capable of analyzing big data or programming on advanced level.

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References:

Agirrechu, A.A. 2009. Technology cities of Russia: history of formation and development. Moscow: Publishing house of the Moscow University, pp. 192.

Bokarev, Yu.P. 2007. USSR and establishment of post-industrial society in the West, 1970-1980s. Moscow: Science.

Borovkov, A.I., Burdakov, S.F., Klyavin, O.I. 2012. Modern engineering education. CSR North-West, pp. 80.

Bystrova, I.V. 2003. Military and industrial complex of the USSR in the 1920s-1980s: economic aspects of development. Economic history: yearbook, 2003, 234-248.

Chevardin, A.V. 2013. The Soviet Union in the era of Stalin modernization (1928-1939)], Moscow.

Coccia, M. 2015. Technological paradigms and trajectories as determinants of the R&D corporate change in drug discovery industry. International Journal of Knowledge and Learning, 10(1), 29-43.

Danilina, E.I., Gaifutdinova, E.S., Kuznetsof, N. 2015. Reduction in Budgetary Expenditure on Social Services as one of the Russian Economy Stabilization Plan Direction. European Research Studies Journal, 18(4), 247-260.

Delloitte in Switzerland. Industry 4.0 Challenges and solutions for the digital transformation and use of exponential technologies. 2015, pp. 28.

Denisova, I.P., Rukina, S.N., Samoylova, K.N., Takmazyan, A.S. 2017. Financial Instruments of the Socially Responsible Economy. European Research Studies Journal, 20(1) 284-293.

Drucker, P. 2014. Innovation and entrepreneurship. Routledge.

Glazyev, S.Yu., Dementyev, V.Ye., Elkin, S.V., Kryanev, A.V., Rostovsky, N.S., Firstov, Yu.P., Kharitonov, V.V. 2009. Nanotechnology as a key factor in the new technological paradigm in the economy. Moscow: Trovant.
Hill, C.W., Jones, G.R., Schilling, M.A. 2014. Strategic management: theory: an integrated approach. Cengage Learning.
Kitova, O.V., Savinova, V.M., Dyakonova, L.P., Bruskin, S.N., Beshmelnitskiy, A.A., Danko, T.P. and Sekerin, V.D. 2017. Information-Analytical System for Forecasting Indicators of the Social and Economic Sphere of the Russian Federation. European Research Studies Journal 20(4A), 275-283.
KPMG, The factory of the future: Industry 4.0 – The challenges of tomorrow. 2016, pp. 66.
Lebedev, V.E., Lebedev, V.E. 2014. Practice of innovation-driven growth of the region (based on the Urals materials). Industrial Urals. Bakunin readings: Industrial modernization of the Urals in the XVIII-XXI centuries. Yekaterinburg, 397-402.
McKinsey Digital. Industry 4.0 How to navigate digitization of the manufacturing sector. 2015, pp. 62.
Muravyeva, L.A. 2012. Abolition of serfdom in Russia: causes, mechanism of realization, meaning. Humanitarian sciences. Bulletin of the Financial University, 2(6).
Perez, C. 1985. Microelectronics, long waves and world structural change: New perspectives for developing countries. World development, 13(3), 441-463.
Perez, C. 2009. Technological revolutions and techno-economic paradigms. Cambridge journal of economics, 34(1) 185-202.
Rodionov, D.G., Fersman, N.G., Kushneva, O.A. 2014. Credibility of the Russian higher education in the world: Problems and solutions. Life Science Journal, 10(11), 43-47.
Rodionov, D.G., Fersman, N.G., Kushneva, O.A. 2016. Russian Universities: Towards Ambitious Goals. International Journal of Environmental and Science Education, 11(8), 2207-2222.
Rogers, E.M. 1995. Diffusion of innovations. New York, 204-251.
Schilling, M.A. 2015. Technology shocks, technological collaboration, and innovation outcomes. Organization Science, 26(3), 668-686.
Schilling, M.A., Kossinets, G., Phelps, C., Porac, J., Powell, W., Rosenkopf, L., Salomon, R. 2012. Technology shocks, alliances, and organizational fields: insights from the global technology collaboration network. Organization Science, 26(3), 668-686.
Shpotov, B.M. 2010. Western sources of the USSR industrialization (late 1930s and 1930s). Collection of reports of the X International Scientific Conference "Problems of the economy and society development." Moscow, April 6-8.
Stroeva, O.A., Mironenko, N.V., Lyapina, I.R. and Petrukhina, E.V. 2016. Peculiarities of Formation of Socially Oriented Strategy of Economic Growth of National Economy. European Research Studies Journal, 19(2), 161-170.
VDI The Association of German Engineers: A Discussion of Qualifications and Skills in the Factory of the Future. 2015. pp. 28.