

Economics of Biotechnological Processes in Sustainable Development

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Abstract. The growth of the world's population and its concentration in large cities increases the pressure on ecosystems and infrastructure, which can be offset by the introduction of "smart" technologies in the urban environment. The increase in life expectancy generates demand for technologies, products, services that provide an active lifestyle, the growth of "age" employment ("silver economy"), high-tech healthcare and personalized medicine. The need to solve food problems stimulates the development of agro- and food biotechnologies, the introduction of new technologies for the industrial production of agricultural raw materials and food products. The consequences of the demographic transition, migration processes and social inequality increase the risks of new epidemics, the return of disappeared infections and, accordingly, the demand for quality and affordable medical services. Changing values, lifestyles, digitalization of society entail the transformation of consumption patterns (economy of sharing, greening, etc.). Under the influence of ICT and their convergence, globalization and digitalization will also cover the field of education, strengthening its interdisciplinary nature.

1 Introduction

The global challenges that the world is facing require a radical transformation of national economies, including their technological modernization, deep structural and institutional restructuring [1]. For modern Russia, integration into these processes is of strategic importance, but is complicated by the diversity of economic sectors, the different speed of their transformation, the low level of innovation culture of key players, for whom innovation has not become the main source of competitiveness, a strategic priority. Solving such problems has long become a managerial routine for global leaders. For Russia, overcoming them is still postponed to the future, and relevant approaches and tools are often considered innovative and debatable. There is no clear agreed understanding in the professional communities and authorities on the multitude of issues relevant to the scientific and technological development of the country [2]: • What are the global challenges facing the world economy, and how are they projected onto Russia, provoking the emergence of certain threats or opportunities? • What will be the shape of key sectors of

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the world economy? What are the prospects for Russia's technological and industrial specialization in the context of global digitalization and the new industrial revolution? • What is the fate of traditional markets and the prospects for the emergence of new ones? • What technologies can act as drivers for the development of the Russian economy? • What requirements for personnel and their competencies are generated by the transformation of the technological structure of the economy? • What is the role of science in shaping the springboard for a technological breakthrough? • How are the face of science, its organization and mechanisms of functioning changing? • How relevant are modern models of open science, open and inclusive innovation for Russia? Answering these questions requires an integrated approach to setting priorities for technological development and forming an effective state policy in the field of science and technology.

2 Research methodology

Threats to Russia are determined by the projected decline in the country's population, the growth of migration flows from Asian countries, the spread of infectious diseases (HIV, tuberculosis, etc.), and a possible decrease in the standards of social services and the quality of life [3]. Progress may be constrained by such factors as uneven access of certain regions of the country and social groups to advanced technologies, including high-tech medicine and the latest medicines, and the low level of citizens' participation in lifelong education. Overcoming these threats will be hindered by the lag in the research, experimental, production and technological base and educational programs, the "brain drain" to countries with more favorable living conditions and professional activities [4]. The windows of opportunity for Russia are connected with the implementation of the reserves of inclusive development - the involvement of the older population and persons with disabilities in labor activity; increasing the availability and quality of medical services, including measures to prevent and prevent diseases; development of remote territories through the digitalization of the economy; increasing the accessibility of education; improvement of migration policy (balanced economic and socio-cultural integration of migrants); the revival of industrial single-industry towns as centers of innovative development; mobilization of creative and cultural value potential and entrepreneurial energy for the implementation of a technological breakthrough [5]. At the same time, natural resources (mineral raw materials, water, land, forests, etc.) are being depleted, and competition for them is intensifying. With the accelerated growth of the Earth's population, its natural agro-climatic potential decreases, and the problems of food supply are exacerbated. Environmental pollution negatively affects the health and quality of life of the population [6]. In the forecast period, demand for hydrocarbons and their high price volatility are expected to remain, which will require an increase in the resource and energy efficiency of the economy, the expansion of the use of renewable energy sources (RES), the introduction of more stringent environmental standards, and new technologies for processing and disposing of waste. The most significant threats to Russia include the increased aridity of the black earth agro-industrial regions, the increase in electricity costs for cooling and air conditioning, the operation of freezers, the increase in the number of natural disasters and the economic damage from them. It is likely that pathogens of epizootics and epiphytotics will spread to uncharacteristic areas for them. Degradation of permafrost will lead to deterioration in conditions and increase in the cost of oil and gas production, which, combined with the depletion of cheap reserves of high-quality hydrocarbons and their low recovery rate, threatens to exhaust the possibilities for extensive economic growth.

3 Results and discussions

As a result of the globalization of economic relations and the spread of new technologies, global value chains are concentrated around the centers of knowledge creation, the importance of “smart” specialization of countries and regions based on existing scientific and technological reserves is increasing [7]. The ability to create new products, modernize production, organizational innovations are becoming one of the key factors for ensuring the flexibility and adaptability of production to demand, successful integration into value chains and long-term competitiveness of enterprises and the economy as a whole. New models of open innovation are based on large-scale networking, pre-competitive cooperation, active trade in technologies and other objects of knowledge capital. These changes concern not only large enterprises, but also scientific organizations and universities, small and medium-sized businesses, innovation infrastructure facilities and other participants in the innovation process [8]. Institutional mechanisms are being transformed, including providing a favorable environment for entrepreneurship, protection and commercialization of intellectual property rights. Business models based on the principles of the sharing economy and electronic platforms will make it possible to eliminate intermediaries from production chains and reduce inefficient costs for companies and the public [9]. The structure of the labor market is changing under the influence of robotization processes, the replacement of routine work with artificial intelligence, the dynamic updating of requirements for competencies and skills, the growth of remote employment and labor mobility. The key threats to Russia are the persistence of a low share of value added created in the country; models of catch-up development and technological dependence on foreign suppliers; imbalance of supply and demand in the labor market, including a shortage of highly qualified specialists; barriers to population mobility; autonomy of science from the real sector of the economy; weak innovative activity of enterprises; unfavorable investment and business climate; generally ineffective mechanisms for protecting property rights and ensuring fair competition. Russia runs the risk of remaining a global supplier of innovative raw materials, while its material and intellectual capital will continue to be absorbed by transnational companies [10].

Today, the world is witnessing a transition to multipolarity, an increase in regional instability, an intensification of the struggle for spheres of influence, an increase in differences in the interpretation of international legal norms, and the emergence of new standards and rules. As a result, the requirements for the effectiveness of relevant instruments and institutions are increasing, and new international and regional blocs and alliances are emerging. In response to the “great challenges”, the role of states and the policy agenda are changing. Political and economic alliances will be formed around the new centers of power. Economic and trade levers of geopolitical influence are spreading, including tightening restrictions on the movement of people, the flow of technology, knowledge, capital, products and services [11]. Growing threats to environmental, energy, food, cyber security, military conflicts and terrorist attacks may become a reason for increased state intervention in the economy and private life. For Russia, the growth of these and other threats is likely, the increase in foreign policy pressure on world and domestic markets due to the increase in conflict in international relations, attempts to oust Russia from among the countries that determine the new “rules of the game”. Windows of opportunity are determined by maintaining the stability of the internal political and economic situation, strengthening/establishing mutually beneficial cooperation with traditional and new players in the global arena, active participation in the formation of new management institutions, equal norms and rules of international relations [12]. The consequence of natural, climatic and environmental trends in the world will be a decrease in the agro-climatic potential of the planet, depletion and withdrawal from agricultural circulation of land resources, a drop in the yield of basic food crops (including wheat, rice and corn), and aggravation of the problems of providing the population with food in

developing countries. At the same time, these factors stimulate the development of agro- and food biotechnologies, technologies for the industrial production of agricultural raw materials and food products. The formation of a new paradigm of scientific and technological development opens up wide opportunities for improving the efficiency of the agro-industrial complex based on the digitalization of production management and the introduction of new resource-efficient production processes. “Smart” agriculture, based on the use of automated decision-making systems, integrated automation and robotization of production, design and ecosystem modeling technologies, is able to provide effective, environmentally friendly pest control, restoration and conservation of useful properties of soils and groundwater, remote integrated monitoring of compliance certification requirements for organic agriculture.

4 Conclusions

Windows of opportunity for Russia are associated with the use of human capital and scientific achievements to involve domestic companies in high-tech parts of value chains, modernize capacities, optimize production processes, gain a foothold in new markets, including niche high-tech ones; creating conditions for the localization of advanced technologies and managerial competencies; reduction of transaction costs as a result of adaptation to changing forms of economic relations [13]. Taking into account the technological backwardness in a number of sectors of the economy, the creation of industries based on fundamentally new technological and organizational innovations, the formation of technical regulations and standards that are ahead of established international practice will be of particular importance. The formation of a new paradigm of scientific and technological development is due to the pronounced orientation of technological changes towards strengthening the cognitive and physical capabilities of a person, including in connection with the unfolding of a new industrial revolution (creation, convergence, penetration into all areas of ICT, artificial intelligence, robotics, biotechnologies; practical use of materials with desired properties, modern electronics, new energy sources, methods of its storage and transmission) [14]. A significant factor in the transition to a new paradigm is the digitalization of research and experiments, the development of new methods and technologies for their implementation (modeling, big data processing, robotization of experiments, network tools for analyzing and exchanging information, etc.). The interdisciplinarity of R&D is growing, and the capital intensity of the research infrastructure is growing. Scientific and technological advances increasingly affect socio-cultural, ethical and legal issues. Social orientation becomes the basis for new management approaches in the paradigm of “responsible” research and innovation. Under these conditions, many countries are actively moving to a new model of organizing and supporting science, in particular, based on the harmonization of institutions and the effective adaptation of the best international practices to national conditions. The key characteristics of the model are the strengthening of the strategic orientation and attention to the global context of the policy, its focus on solving socio-economic problems, achieving specific goals and effects (productive knowledge); emphasis on increasing the requirements for the productivity of scientific activity; stimulating the transfer of knowledge and the commercialization of technologies created in scientific organizations and universities (including on a network basis, the principles of superiority and openness), the innovative activity of companies in various sectors of the economy; development of international cooperation, in particular in the implementation of megascience projects and the creation of global centers of excellence. Contacts between scientists from different countries are intensifying, which leads to an increase in academic mobility, international co-authorship and joint patenting.

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