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**MECHANISMS IMPLANTATION OF INTELLECTUAL
CLUSTERS IN THE STRUCTURE OF THE ECONOMY**



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Abstract

New digital technology platforms are increasingly defining the basis for the sustainable development of an innovative economy. In an innovative economy, based on key technological platforms, regimes and mechanisms, the maximum amount of new scientific knowledge is materialized and the inefficient use of traditional economic resources in production, exchange, distribution and consumption is minimized. In the modern economy, key technologies determine the direction of development. As revolutionary discoveries based on exceptionally new and unique principles, they give scope to the flow of radical innovations. On the basis of key technologies, unique technical and economic mechanisms based on the interaction of qualitative factors of sustainable innovative development of the economy appear and are used. Rapidly developing scientific, technological, educational and intellectual platforms as mechanisms for implementing sustainable development of an innovative economy are effective only within the potential of progressivity. The accumulation of fundamental knowledge is a cumulative and continuous process, and the losses associated with the underestimation of fundamental research at the previous stage cannot be quickly compensated. Under the influence of the information technology revolution, the sustainable development of an innovative economy becomes an active permanent process if the condition of potential progressivity is constantly met. The principle of changing technologies affects a wide area, including the education system, production, and research industry. In such conditions, the importance of the innovation sphere is growing, since there is an endogenous demand for innovation.

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1. Introduction

The diffusion of critical technologies creates new markets and ensures sustainable innovative development of the economy. At the same time, new productive forces are emerging that are effective enough to implement intensive changes in the paradigm, style and way of life of the population.

The development of technological structures, platforms, systems, modes and complexes within the life cycle is subject to the General laws of dialectics, and changes in the main technical and economic characteristics over time (power, productivity, speed, number of systems produced) are influenced by technological revolutions.

The digital revolution allows us to adjust the trajectory of sustainable innovation development, taking into account the permanent accelerated innovation metamorphosis of the economy. By innovative metamorphosis, we mean technological modification, transformation, transition to another form of development with the acquisition of a new type, mechanism and functions under the influence of the digital revolution.

2. Problem Statement

The development and release of fundamentally new technologies is associated with the need for an innovative metamorphosis of the economy and involves higher R&D costs, and accelerated diffusion of innovations. The necessity and expediency of changing the technological basis is dictated by the inevitable decline in macroeconomic efficiency during the period of stabilization of the technology Park. Stabilization of the technology Park means approximate equality of technologies written off and received annually, i.e., the state of dynamic equilibrium of the technology Park composition. As a criterion for solving the problem of optimizing the frequency of technology changes, the minimum total macroeconomic costs for the entire planned period of production of a certain number of technology models is taken.

3. Research Questions

Theory and practice show that there are rational deadlines for the release of the basic model, within which it is more profitable to carry out modernization. Therefore, after these deadlines, it is necessary to accelerate the transition to the creation and release of fundamentally new technologies. Modification of the basic technology model occurs only within its life cycle. Terms of changing technologies and the acceptable duration of their use using the concept of progressivity potential. Which refers to the period during which the technical and economic indicators of this model meet international standards. It should be noted that the potential for technology progressiveness is a predictable value and applies to both the basic model and its modified substitutes. The maximum duration of mass production of technologies should not exceed their potential for progressiveness. At the same time, the term of technology change in the optimal case should be less than the potential of progressiveness by the value of its service life. If this condition is met, the economy will constantly use technology that meets the requirements of international standards.

4. Purpose of the Study

The article uses dialectical principles to identify the content of economic processes and phenomena, to determine the trends of their development. The study used General scientific methods, as well as the interaction of the economy with the social and environmental sphere.

5. Research Methods

The article uses dialectical principles to identify the content of economic processes and phenomena, to determine the trends of their development. The study used General scientific methods, as well as the interaction of the economy with the social and environmental sphere.

6. Findings

Rapidly developing scientific, technological, educational and intellectual platforms as mechanisms for implementing sustainable development of an innovative economy are effective only within the potential of progressivity. The accumulation of fundamental knowledge is a cumulative and continuous process, and the losses associated with the underestimation of fundamental research at the previous stage cannot be quickly compensated. Under the influence of the information technology revolution, the sustainable development of an innovative economy becomes an active permanent process if the condition of potential progressivity is constantly met. The principle of changing technologies affects a wide area, including the education system, production, and research industry. In such conditions, the importance of the innovation sphere is growing, since there is an endogenous demand for innovation.

The constant updating of the technological basis implies the formation of the scientific and technological infrastructure of the economy, which could be used to ensure high quality and changeability of technologies, including innovation. In the focus of such infrastructure, the importance of technology platforms is increasing, and the requirements for mechanisms for accelerated diffusion of innovations are increasing (Patinson, 2013). The condition for implementing such a macro-economic infrastructure, which is innovative in nature, is a combination of technological, scientific, production and intellectual platforms that can create an effective combination of production, science and education. Effectively functioning technological, scientific, production and intellectual platforms, firstly, produce all innovative ideas and concepts; secondly, they form a variety of strategic alternatives for the development of production. These platforms concentrate the power of research and production potential, increase the flow of unique innovative ideas, generate them, and promote their sustainable implementation. These platforms offer significant opportunities to create new business models and materialize exclusive ideas (Parker, 2017). The main task is to expand basic research on the development of next-generation technology. Priority is given to the most promising developments that pave the way for radical innovations in such areas as nuclear and thermonuclear energy, the aerospace complex, the development of Arctic resources, nanotechnology, biotechnology, information technology, the creation of new materials, and environmental technologies. This requires reforms of the economic mechanism, innovative management methods, changing the direction of the technical and economic mechanism, overcoming its inertial nature, focusing on improving quality

and efficiency, accelerating scientific and technical research, and strengthening the intellectualization of the technological basis of production. In this context, innovative technology platforms are important and crucial. The conducted research makes it possible to define technological platforms as local spatial concentrations of effective interfaced production technologies, research centers connected by design bureaus, and institutes specializing in the creation and dissemination of innovative technologies and corresponding infrastructure subsystems. Their functioning implies a high level of development in the fields of science and education, significant integration of innovative production structures, and orientation of the technological strategy of innovative firms to achieve long-term goals. Technology platforms are local technological systems, design and research centers, and academic institutions where theoretical knowledge is created, verified, and codified and materialized in technologies and products.

Functioning technology platforms, thanks to flexible logistics, have high opportunities for sustainable and effective economic interaction with various spheres and territories (Light & Miskelly, 2019).

Within the framework of sustainable innovative development of the economy, under the influence of the digital revolution, platforms are being intellectualized. This quality becomes the determining factor of the emerging exclusive technological method of production. An important sign is that R&D is gradually becoming an integral part of the knowledge-intensive technology platform. At the same time, there is an accelerated merging of science and technology. High-tech technology platforms are distinguished as independent exclusive technological units. Digitalization of technologies, despite all the uneven coverage of industries and sectors and its quality level (for example, artificial intelligence systems, including design visualization, are still in the initial stage), creates a qualitatively different technological basis – more knowledge-intensive.

A fairly stable trend is being formed when innovative production is developing within the framework of technological platforms. Accessibility is now becoming a strategic direction for the development of key technologies. These technologies are entering a phase of their sustainable and universal application. At the same time, sustainable business models of joint action are being formed (Aluchna & Rok, 2018; Herrmann-Fankhaenel, 2018). In this situation, a new market design and basic principles for regulating the sharing economy are being formed (Konovalova et al., 2020; Petropoulos, 2017).

This trend is related to the qualitative shift that has occurred in the nature and content of the innovative metamorphosis of the economy. On this basis, there was a transition from mainly physical to mainly intellectual work as the basis for sustainable innovative development of the economy. This metamorphosis entails unique changes in the principles, content, methods, technical means and organizational forms of innovative production. The innovative needs of society imply a sharp qualitative technological metamorphosis of the economy, which is possible within the framework of the latest scientific, technological and intellectual platforms. These platforms should transform scientific knowledge into resources, technologies, goods and services through certain mechanisms. We believe that the formation and development of scientific, technological and intellectual platforms and mechanisms for their use will accelerate the creation of the potential for sustainable innovative development of the economy in the context of the modern digital revolution.

The strategy of sustainable innovative development of the Russian economy is related to the need for high-quality modernization in the system of interaction of productive forces and institutional relations. The generally accepted formula for sustainable innovative development of the economy is maximum results with minimum costs (Drahokoupil & Piasna, 2017).

The modern digital revolution increasingly determines the trajectory of sustainable innovative development of the economy. A new principle of interaction between factors of production is being formed and is operating, based on a system of innovative technological modes and platforms that reduces the value of traditional resources and saves the global environmental space (Konietzko et al., 2019). The development of high-tech industries, science, education, and improving the quality of life is determined by how effectively new knowledge is used as an important strategic economic resource.

In many cases, the innovative products and services produced are system-forming and unique. Producers receive exclusive rents from each stage of the expansion of aggregate demand, not only in the product cycle, but also in the global process of changing the nature of production and the entire way of life. For us, taking into account global best practices is very necessary and important for correcting and specifying the trajectory of sustainable innovative development of the economy.

A new economic situation was being formed, when society is forced to continuously develop its scientific, technical, scientific, educational and intellectual potentials as the leading foundations for sustainable innovative development of the economy (Gasnov et al., 2019). Our research allows us to suggest the following optimal scheme for the transition to this type of economic development. It contains the following unique mechanisms and systems: 1) adequate economic, social, and institutional measures. organizational and other mechanisms; 2) mechanisms of production, reproduction and sustainable creative growth and development of human capital; 3) a super - fast national information infrastructure that meets the needs of the economy; 4) an effective national innovation system; 5) an effective and high-quality national scientific and educational system that is part of global structures; 6) a national infrastructure for environmental protection.

Sustainable creative development of human capital implies the formation of an intellectual cluster as the basis of competitive advantage (Porter, 1998). With the help of such a cluster, it would be possible to ensure high quality of human capital, including innovative areas, while identifying difficulties in their preparation. An intelligent cluster can create an effective combination of science and education that meets new economic parameters. An effectively functioning intellectual cluster, first of all, produces all innovative ideas and concepts; second, it creates a variety of strategic alternatives for sustainable creative development of human capital. This cluster concentrates the power of scientific and educational potential, increases the flow of innovative ideas, their generation and promotion of their implementation. These local clusters contain significant opportunities for implementing the country's creative potential. They are characterized by active actions, openness to changes, flexibility, consistency, that is, receptivity to exclusive scientific and educational, scientific and pedagogical solutions, and the ability to create conditions for the development of innovative technologies by other industries and sectors of the economy. Smart clusters are local spatial concentrations of effective connected universities, research centres, related industries and institutions that specialize in creating and distributing innovative technologies and related creative infrastructures. Their functioning in the economy implies a high level of development of the system of

science and education, significant integration of University employees in innovation and production structures, and orientation of the economic strategy to achieve long - term innovation goals.

In developed countries, intellectual clusters have been formed and are developing, with clear and established mechanisms of intervention and implantation. The intervention mechanism refers to the active penetration of one or more intellectual clusters into the internal structures of the innovation economy. These are world-class universities, modern research centres, and academic institutions, as Bell (1967) wrote, "where theoretical knowledge is created, tested, and codified, becoming the main institutions of the new society" (p. 1). The mechanisms of implantation of intellectual clusters are understood as active implantation of intellectual structures into the innovative fabric of the economy and the development of their interaction. Functioning smart clusters, thanks to flexible logistics, have high opportunities for dynamic interaction.

Within the framework of sustainable innovative development of the Russian economy, intellectual labour becomes the dominant type of labour in the coordinates of the new social division of labour and, accordingly, its flexibility and adaptability increase.

As part of the rapid growth of R&D, the cognitive function of intellectual activity is being replaced by the transformative one. Creative thinking is distinguished as a special and independent form of activity of intellectual workers. In practice, all this is implemented in developed countries and creative thinking occupies a unique place among other qualitative characteristics of employees. Therefore, the formation of modern creative thinking is one of the priorities of the intellectual cluster. The world's leading universities are already taking this aspect into account. This trend is related to the shift that has occurred in the nature and content of social work under the influence of the digital revolution. Intellectual clusters turn knowledge and education into a direct productive force, which is called the main capital of the economy. The development of intellectual clusters provides the potential for sustainable innovative development of the economy.

Under the influence of the digital revolution, the structure of the economy is dynamic and highly effective synthesis of such dominant technological components as "information", "technology" and "communication" is carried out. As global best practice shows, biology, electronics, and computer science seem to converge and interact in applications, the discovery of new materials, and, more fundamentally, in their conceptual approach (Zhironkin et al., 2019). Introduction to almost any technique of "intelligence" in the form of a computer includes trends leading to a new technological basis. In the new conditions, the way of thin technologies begins to manage all technologies – the technological basis of the economy (Kelly, 1998). This accelerates the intellectualization of the entire system of national production, which is already based on new technical and economic principles. In Russia, in the areas of Biomedicine, bioinformatics (computer biology), bionanotechnology, laser technology, mathematics, and theoretical physics, brilliant work has been done on a global level. Research is being conducted in many countries, but Russia is firmly in the lead. Laser physics made it possible to control light. This led to a chain of epochal discoveries in coherent linear optics. Lasers have found many applications in medicine. It is important that lasers turned out to be an interdisciplinary field where the achievements of many disciplines converged. Interdisciplinary are a key feature of modern science. A distinctive feature of modern science is the combination of fundamental research activities with the solution of applied problems. Currently, physics at the intersection

with medicine has made a rapid leap due to the achievements of natural Sciences and the appearance in its Arsenal of the latest physical equipment. Using the laws of quantum mechanics changes the nature of matter. This is achieved through promising technologies that use the laws of quantum physics at a fundamentally new level. One of the most important areas of development of Russian science is quantum Informatics. The result of this scientific activity can be absolutely safe and inaccessible to hacking data transmission networks, submicron optical transistors and high-frequency optical electronics, new systems for ultra-sensitive brain tomography, compact and accurate clocks for navigation systems. A feature of the modern information technology revolution is, according to Castells (1996), not the Central role of information, "but the application... of information to knowledge generation and information processing and communication devices in the cumulative feedback loop between innovation and the use of innovation" (p.1). At the same time, the information caused a huge increase in labour productivity in developed countries. The problems and prospects associated with the emergence of new resources naturally indicate changes in macroeconomic parameters. The structure of the economy undergoes numerous changes as it develops steadily and innovatively, and the economy itself goes through various stages of modernization. Innovative scientific and technological potential is being formed, and on this basis, trends are observed in the economy: 1) expanding opportunities for the generation of new economic, social and cultural goods that contribute to solving specific problems; 2) facilitating, as a result of sustainable innovative development, the familiarization of individuals with genuine economic, social and cultural goods, and their widespread dissemination; 3) changing the way of life of the population due to new economic achievements.

The digital society needs to influence all layers in order to form their knowledge, skills, needs and interests, thinking style and practical activities that correspond to the principles and norms of sustainable innovative development of the economy (Gasanov et al., 2020). Today, the most competitive firms are those that are able to constantly improve taking into account technological innovations and implement them. The idea of training in the production process, aimed at achieving technological advantages, is widely spread. The concept of learning in the production process was first described in detail (Arrow, 1962). Traditional theories of economic development focused on traditional factors. In new growth theories, the digital revolution is seen as the main link in development (Konovalova et al., 2020). This theory treats technological change as an endogenous process. Under these conditions, there is an increase in economic incentives for technological changes: the share of R&D expenditures in total GNP is growing. Therefore, a new macroeconomic situation, which occurs simultaneously and the growing importance of such factors as human capital, present in new growth theories as a non-persisted technological advance, and growing importance of technological progress persisted.

Within the framework of sustainable innovative development of the economy, revolutionary changes in technologies that lead to sustainable productivity growth provide a deep transformation of production, where the individual comprehends all the processes that occur and generates new ideas. This, in turn, leads to the transformation of the overall production, social and environmental structures created as a result of organizational interactions of capital, information and technology flows. The focus on using knowledge and high technologies as a strategic economic resource creates the necessary prerequisites for its sustainable innovative development of the economy. We believe that sustainable innovative

development of the economy is defined as a creative process of creating new productive forces, better technological processes, effective management systems that exclude environmental conflicts. The development of the information technology revolution implies a sharp increase in the use of intellectual resources as the main renewable resource for ensuring sustainable innovative development of the economy. N. Gorgescu-Rougen considered the economy as a new form of biological life and associated with it both the possibilities of entropy and the prospects for development into a more complex form (and overcoming entropy processes due to this) (as cited in Blaug, 2008). In the foreseeable future, new factors should become the basis for sustainable innovative development in the face of declining natural resources and increasing likelihood of environmental conflicts. Society has reached the point where sustainable innovative development of the economy becomes impossible without a radical change in the paradigm of its relations with the biological, technological and social sphere (Han & Jin, 2018).

Environmental progress in a free, spontaneous market leads to resource depletion and cannot by itself ensure the competitiveness of resource-saving technologies in comparison with resource-intensive ones. Nor can the administrative economy provide this. Obviously, new models of global development are needed that focus on the survival of humanity in conditions of minimizing resource consumption (Bindzar et al., 2019). New models of global development will be based on new principles of physics and other natural Sciences that differ from those that formed the scientific and theoretical basis of the industrial economy.

7. Conclusion

Sustainable innovative development of the economy involves focusing on new knowledge that ensures the integrity of the biosphere, transforming technological processes, obtaining new high-quality materials and products, increasing labor productivity and reducing the cost of all resources and meeting the needs of society. Increasing the share of intangible resources is a fundamental and dominant feature of sustainable innovative development of the economy in the coordinates of the digital revolution. The stability of the processes of innovative development of the economy is an indicator of the active manifestation of the mechanisms of its self-movement.

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