The concept of greening in the neo-industrial development of regions

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Abstract: *An analysis of methodological approaches to the development of a strategy for neo-industrial development of the economy of various levels was carried out. The absence of systematic ideas about the mechanisms of influence of convergent (NBIC) technologies on existing production processes and the functioning of societies with the prevalence of predominantly overestimated expectations is shown. A local assessment of the effectiveness of the application of convergent technologies forms the prerequisites for the emergence of risks with unpredictable social and environmental consequences. The methodological imperfection of the concept of technology convergence is shown, due to different principles for the development of technologies with given functionality.*

The principle of intellectual convergence is proposed, the implementation of which in the form of integration interaction of the intellectual potentials of institutional components allows minimizing the risks in the innovative activity of business entities and the sustainable development of societies.

An expedient methodological approach to implement intellectual convergence is the green life cycle of innovative products.

Keywords*: CONCEPT OF GREENING, NEO-INDUSTRIAL ECONOMY, CONVERGENT TECHNOLOGIES, REGIONAL DEVELOPMENT, INTELLECTUAL SUPPORT, INTELLIGENT CONVERGENCE, GREEN CYCLE*

1. Introduction

The economy of technologically developed countries is in the stage of transition from the fifth to the sixth technological mode, the core of which is considered high-level technologies, united by the concept of convergent technologies - nano-, bio-, info-, cogno- (NBIC) [1–12]. The main resource for the development of these technologies and their practical applications is intellectual products of various content and scope, which are developed on the basis of knowledge about the essence of the processes of existence of the material world and society [1–13]. There has been a characteristic trend in the use of the term "intellectual" to characterize the processes that ensure the transition of the traditional economy to a new one ("post-industrial", "neo-industrial", "digital"). At the same time, there is a different assessment of the effectiveness of the use of convergent technologies in the economic development of both the global system and its state, regional and subjective components.

So in [14] it is believed that the economy is undergoing a structural shift due to quantitative and qualitative changes [15], and this shift is "characterized by the key role of *convergent technologies based on recreating the principles of wildlife in technological processes that have the ability to penetrate and significantly synergistic potential*" (emphasis added – O.A., A.S., A.A.) [15, p. 25].

The statement about the possibility of using convergent technologies to "recreate the principles of living nature" appears in the works of a number of Russian researchers without a systematic analysis of their essence and consequences of their application for the development of the economy and social systems [1–3, 14–17]. For example, in [13–17] they believe that "*Nanotechnologies and biotechnologies provide the key to changing the world of artifacts and wildlife, including human biology at the most fundamental level*" (emphasis added – O.A., A.S., A.A.) [3, p. 65].

At the same time, in the studies of Russian and Belarusian specialists, negative aspects of the practical use of convergent technologies in the development of economic and social complexes were noted [19–23]. So, in [19], it is noted: "... Through the efforts of the National Research Center "Kurchatov Institute" in 2009, the Kurchatov complex of NBIC technologies was created. But already in the second half of the 2000s, interest in the topic of the NBIC(S) began to fade" [19, p. 558].

The optimistic forecasts set out in [21] that "... *the period from 2014 to 2018–2020. will be the most favorable for the development and dissemination of a new wave of basic innovations based on NBIC convergences*"(emphasis added – O.A., A.S., A.A.) [21, p. 222], did not materialize, and real results studies of convergent technologies in the economy of not only developed countries, but also developing countries are far from expected. For example, in [22, 23], the current state of practical application of a number of convergent technologies, in particular nanotechnologies, is assessed as a crisis.

In our opinion, the assessment of the prospects for the use of convergent technologies in the aggregate or their individual components is of significant scientific and practical interest, both in terms of economic efficiency and in terms of possible risks in various forms of their manifestation, including environmental ones.

2. Results and Discussion

To analyze the features of the influence of convergent technologies on the development of economic and social systems, we will proceed from the accepted norms that determine their essence. The key components of the NBIC complex include nanotechnologies, which allow the formation of material objects of various functional purposes for information, biological, and cognitive technologies. According to [24], nanotechnologies deal with processes occurring at the so-called "nanolevel". Therefore, depending on the position of the researcher, *nanotechnology* considers *as an object both the nanoobjects themselves and the materials based on them* "nanomaterials", "nanocomposites" (emphasis added – O.A., A.S., A.A.).

Therefore, the opinions widespread in literary sources, mainly of a humanitarian content, that "... *Nanotechnologies have appeared ... the logic of development of which is designed to combine the existing highly specialized science and sectoral economics into a single picture of natural science, but at a new level of development of civilization*, a new technological way of industrial production based on the study of individual atoms and molecules" (emphasis added – O.A., A.S., A.A.) [18, p. 7], and that "*Nanotechnology is a fundamental modernization of all existing disciplines and technologies at the atomic level. Nanotechnologies change the principle of creating materials, their properties*, that is, the foundation for the development of all sectors of the economy of the post-industrial society without exception " (emphasis added – O.A., A.S., A.A.) [18, p. 7], and from the point of view of technical applications it's have a pronounced ambiguous character.

It seems to us unreasonable and, from a technological point of view, not sufficiently correct to say that "... *a new stage of development begins, when we are ready to move from technical model copying of a "human device" based on relatively simple inorganic materials to reproducing wildlife systems* based on nanobiotechnologies" (emphasis added – O.A., A.S., A.A.) [16, p. 15].

The practical spread of these technologies has shown an incorrect and overestimated assessment of human potential, which pushes for the need to create "artificial intelligence" and the so-called "posthuman".

Different understanding of the essence of nanotechnologies in the research of specialists in the field of humanities and technical sciences, has led to inflated expectations associated with the rapid spread of these technologies in the real industrial sector.

A number of researchers believe that modern structural policy is being formed in the context of a deep crisis in the nanoindustry [22, 23]. In their opinion, the point is not even that the "trillion-dollar markets" that were predicted to be formed before 2015 have not been reached, but also that the existing system of adequate perception of scientific developments in the field of nanomaterials science and nanotechnologies by existing industries in mechanical engineering, energy, chemical industry, construction, processing industry, that is, in those sectors that determine the sustainable economic and social development of regional and state economic complexes. In [22], it is rightly noted that the spread of assessments of the effectiveness of nanotechnologies is due to the fact that, firstly, "*we are talking about a technology of wide application, the potential of which has not actually been revealed even at the level of fundamental research*", and secondly, " ... the total cost of products produced using nanotechnologies is taken into account, and not the cost of nanomaterials and nanotechnologies themselves ....", thirdly, "... building descriptive models of the future economy based on the nanotechnological order" (emphasis added – O.A., A.S., A.A.) [22, p. 29–30].

Therefore, fair is the conclusion of Danilin I.V. that "... *despite the success of technology convergence since 2000. the concept turned out to be poorly operable, becoming rather a metaphor for the growth of interdisciplinarity*" (emphasis added – O.A., A.S., A.A.) [19, p. 555]. The conclusion about the prospects for the development of the concept of convergent technologies is substantiated: "... its (concept) revolutionary potential is really significant. However, it was *associated not so much with technological as with institutional and socio-cultural transformations. In particular, this is the development of human capital, a change in the logic of the organization of scientific and technological work, state policy, the formation of a new culture and ethics of R&D, the systematic improvement of national innovation systems. Moreover, these ideas implicitly embedded in the concept were most significant just for developing countries*, being a key condition for accelerating their growth and changing the quality of their development" (emphasis added – O.A., A.S., A.A.) [19, p. 555].

Analysis of literature sources devoted to the problem of innovative development of the economy using high-level technologies ("convergent", "breakthrough", etc.) [1–8, 11, 12, 14–23, 25–30] indicates the ambiguity of risk assessments, due to the qualitative transformation of systems for the production of commercial products, their consumption, information, logistics, personnel and other support. Primary attention is paid to the social risks of the transition of the economy to a neo-industrial strategy. So, in [30] they note that "*The strategic course for the implementation of a new industrial policy should cover not only the technological and economic systems, but the system of social relations, in particular relations that develop in the process of labor activity*" (emphasis added – O.A., A.S., A.A.) [23, p. 20]. In our opinion, the formation of these relations is possible through the *intellectual interaction of the participants in the production process within the framework of innovation activity and the sphere of consumption of innovative products*.

The concept of "intellectual interaction" is implemented in the form of a system of intellectual support for the innovative activity of industrial enterprises of various functional purposes, sectoral subordination and form of ownership.

The concept of intellectual support for innovation activity proposed by us makes it possible to eliminate the characteristic methodological paradox in the discussed approach to economic development based on convergent technologies. The essence of this paradox lies in the fact that technology is one of the main end results of systemic research activities, which is developed in accordance with specific goals and objectives of practical application. The developed technology in a specific field of activity (technical, social, educational, marketing, etc.) has pronounced signs of isolation, due to the area of their practical application. Therefore, the convergence (convergence) of technologies from different fields of application and different functional purposes is a very difficult problem after their development. This circumstance reduces the likelihood of achieving a synergistic effect, which manifests itself in the formation of new aggregate values of the parameters of the characteristics of a system in which technologies for various purposes were used.

Thus, the convergence of individual technologies does not have a common methodological basis, but is carried out with a certain transformation for each specific area of application.

The proposed principle of intellectual interaction allows for the convergence (convergence) of the intellectual potentials of specialists from research, educational, industrial components of the innovative cluster structure and develop a product (technology) that optimally takes into account the features of all components with a synergistic effect.

Therefore, the *concept of convergence of intellectual potentials* makes it possible to eliminate the methodological paradox (inconsistency) of the components of functional technologies at the stage of joint development. The implementation of this concept in the structure of a research, educational and production cluster (REPC) [31, 32] makes it possible to transform the educational component for training specialists in the development and implementation of high-level technologies, including convergent ones, by increasing the research and experimental components in the educational process. At the same time, the scientific component of the cluster will expand the scope of exploratory research by involving teachers, students, undergraduates and graduate students of universities in their implementation as part of the implementation of practice-oriented diploma and dissertations with a significant fundamental component.

An analysis of the literary sources devoted to the study of the formation and development of a neo-industrial economy based on the extended use of high technologies [1–23] shows the validity of using the concept of the life cycle of innovative products to develop effective methodological approaches.

The essence of this concept in the context of intellectual convergence is not only the development of innovative products with high consumer characteristics that provide a significant economic effect from the sale in the domestic and foreign markets, but also the minimization of the prerequisites for the formation of a negative technogenic impact on the environment at all stages of the life cycle.

The practical implementation of this methodological approach consists in the development and application of *complete-cycle technologies for green enterprises* for various purposes, departmental subordination and ownership in the application of a *set of green legislation* in the form of state, industry standards and subject regulatory legal documentation (technical specifications, technological regulations, technical processes, etc.) at all stages of the product life cycle. The principles of development and application of these components of the green life cycle of innovative products are considered in [33].

The implementation of the concept of ecologized legislation will reduce the negative environmental consequences of the convergent technologies used, primarily nanotechnologies, biotechnologies, which have an adverse effect on the basic components of flora, fauna and the human body [24, 33].

The practical implementation of eco-friendly life cycles of innovative products based on the concept of intellectual convergence will ensure sustainable economic and social development of the economies of the post-Soviet countries in the near and long term, while maintaining ecological balance.

3. Conclusion

An analysis of modern approaches to the development of a methodology for the neo-industrial development of the post-Soviet states indicates a significant impact of overestimated forecasts for the use of convergent technologies (NBIC-complex) in the current production sector and the social sphere of consumption of innovative products. To develop a strategy for the formation of neo-industrial economies, there is no systematic approach to assessing risks in various forms of their manifestation, which does not allow to fully predict the depth and timing of the onset of negative consequences in the functioning of societies and environmental components.

The concept of intellectual convergence is proposed, which allows, based on the integration interaction of intellectual resources of research, educational and production components, to reduce the likelihood of risk formation in various forms of their manifestation. The expediency of forming, on the basis of the concept of green legislation, green life cycles of innovative products, the practical implementation of which will ensure sustainable economic and social development while maintaining ecological balance, is substantiated.

4. References

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