

ECO-INNOVATION MANAGEMENT IN THE CONDITIONS OF TECHNOLOGICAL REVOLUTIONS AND SUSTAINABLE DEVELOPMENT

The current stage of global development is characterized by a profound transformation of socio-economic systems under the influence of two interrelated processes - the aggravation of environmental problems and a rapid technological breakthrough. On the one hand, climate change, depletion of natural resources, increasing waste volumes and increasing energy consumption create significant threats to the sustainable development of the world economy. On the other hand, the Fourth and the emergence of the Fifth technological revolutions (Industry 4.0 and Industry 5.0) open up fundamentally new opportunities for increasing management efficiency, digitalization of business processes and integration of innovations into environmental practices [1-5].

In these conditions, there is a need for a new management paradigm - eco-innovative management, which involves combining strategic environmental goals with the use of innovative technologies. This not only allows reducing anthropogenic impact on the environment, but also forms the long-term competitiveness of enterprises, which meets the principles of sustainable development.

The purpose of the study is to determine the conceptual foundations of eco-innovation management in the context of technological revolutions and to substantiate its role in achieving sustainable development.

The main direction of eco-innovation management is the implementation of innovative solutions that combine economic effect and environmental feasibility. In modern conditions, business models are increasingly being transformed in the direction of the "green economy" and circular economy, which involves minimizing waste and reusing resources. Eco-innovation covers a wide range of practices: from the use of renewable energy sources and the development of electric transport to the implementation of closed production cycle technologies. Thus, innovation becomes not only a tool for increasing productivity, but also a key factor in the environmental responsibility of business.

An important component of eco-innovation management is the integration of digital technologies of Industry 4.0 into sustainable development strategies. The use of artificial intelligence, big data (Big Data), blockchain and the Internet of Things allows you to create monitoring and management systems that optimize the consumption of energy and material resources, reduce emissions and increase the transparency of environmental reporting. In turn, the concept of Industry 5.0 emphasizes not only digitalization, but also human-centricity, i.e., an orientation towards a balance between technology, environmental requirements and social needs. This forms new approaches to management, where technological capabilities are directed towards creating a sustainable interaction between society, business and nature.

Particular attention should be paid to the transformation of management models. Traditional environmental management, which mainly focused on controlling and reducing the negative consequences of economic activity, is gradually being replaced by proactive eco-innovative management. The latter integrates environmental and innovative strategies into all business processes of the enterprise - from strategic planning and financial decisions to marketing and organizational culture. This approach allows enterprises not only to comply with environmental standards, but also to gain competitive advantages through increased efficiency, innovation and social responsibility.

An equally important aspect is the formation of a corporate environmental culture. The development of environmental thinking among personnel, increased environmental responsibility of managers and the formation of a culture of sustainable consumption are becoming integral components of modern management. In this case, the leading role is played by environmental leadership, focused on long-term sustainability, harmonization of the interests of business and society, as well as ensuring a high level of trust from stakeholders.

It is worth emphasizing the need for institutional and financial support for eco-innovation management. State policy and international organizations should stimulate the implementation of "green" technologies using financial instruments (green bonds, loans for environmental projects, sustainable development funds), standards and regulatory mechanisms. This creates conditions for scaling up environmental innovations and ensures the sustainability of results at the national and global levels.

The development of eco-innovation management should also be considered in a broader global context. The aggravation of environmental risks, the growth of the cost of natural resources and the strengthening of international standards of environmental responsibility form a new logic for the enterprise's functioning. In these conditions, innovations act not only as a means of optimizing costs, but also as a tool for reducing strategic risks associated with dependence on fossil fuels, resource constraints and fluctuations in world markets. The gradual integration of eco-innovations into production and management processes allows businesses to increase their resilience to crisis events, strengthen partnerships with international investors, and enter new markets. Thus, eco-innovation management is becoming a multidimensional tool that simultaneously ensures the efficiency, adaptability, and strategic security of enterprises in the long term.

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The prospects for the development of the transport complex in the context of Industry 5.0 are determined by the integration of innovative technologies and the principles of sustainable development. The transport of the future is focused on combining digital solutions with environmental efficiency: mass implementation of electric transport, development of

infrastructure for hydrogen engines, use of digital twin technologies for real-time management of transport systems. This will not only reduce greenhouse gas emissions, but also increase the efficiency of logistics networks, which is extremely relevant in the context of global challenges of climate change and growing demand for mobility.

The second important aspect is the orientation of Industry 5.0 towards the human-centricity of transport systems. This means creating conditions for safe, accessible and inclusive transport that meets the social needs of the population. The development of "smart" infrastructure, artificial intelligence-based traffic management systems, the introduction of autonomous vehicles – all this is aimed at improving the quality of life of citizens. Social innovations in the field of transport are of particular importance, in particular the development of the concept of Mobility as a Service (MaaS), which integrates various types of transport into a single digital ecosystem for the convenience of users.

In the future, the transport complex in the context of Industry 5.0 will develop as a key driver of the circular economy and "green" transformation. The introduction of resource reuse technologies in the production of vehicles, the development of networks of charging stations based on renewable energy, the use of blockchain for transparent monitoring of the carbon footprint of logistics - all this will contribute to reducing the environmental burden and strengthening the global competitiveness of transport systems. Thus, in the future, the transport sector will be not only a sphere of movement, but also a platform for innovative and sustainable solutions that will shape a new paradigm for the development of the world economy [6-8].

Eco-innovation management is a necessary condition for overcoming modern environmental challenges and effectively using the opportunities of technological revolutions. It ensures the integration of the principles of sustainable development into the economic activities of enterprises, combining economic, social, and environmental goals. In the future, it is eco-innovation management that will determine the global competitiveness of enterprises and countries, contribute to the formation of a "green economy" and the transition to a model of harmonious interaction between society, business, and nature.

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