Machineology as a conceptual basis for the formation of a mining engineering scientific platform

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Abstract. The subject of research is mining machineology as a methodological basis of a scientific platform in mining engineering. The object of research is a scientific platform in mining engineering. The purpose of the work is to increase the efficiency of mining engineering methods. As a result of the study, the importance of mechanical engineering for the formation of a scientific platform in mining mechanical engineering is revealed. The obtained results contribute to increasing the effectiveness of scientific and innovative activities. The result of an innovative project in mining engineering was achieved, taking into account the increased efficiency of using the results of scientific research.

1. Introduction
The relevance of this work is associated with the need to increase the effectiveness of scientific and innovative activities in Russia in 2019 in the interest of giving a new impetus to the development of the economy.

At the beginning of the 21st century, they are exploring in the driving industry: the development paths of mining mechanical engineering attracts LNG scientists [1]; computer-aided design [2]; ensuring the operation of mining equipment [3]; equipment assembly methods [4]; possibilities of nanotechnology [5]; change processes [6]; enterprise reengineering [7]; production efficiency [8]; simulation of service systems [9]; prospects and innovations [10]; integration of education and science [11]; management of scientific services [12]; the availability of scientific results [13]; new approaches to the organization of post-industrial science itself [14] in mining.

Postindustrial mining mechanical engineering is becoming more complicated; the role of implicit knowledge is increasing, related to the integration of facilities for mechanical engineering into increasingly complex technological and industrial complexes. In this regard, the need for systematic integration of knowledge from various fields during the implementation of innovative projects in mining engineering is increasing. Therefore, it is proposed to develop scientific platforms.

By a scientific platform in mining engineering, we mean a systematic combination of scientific knowledge from various branches of science that is necessary to solve during the innovation project the problems of safe and economic creation of mining engineering facilities for the entire depth of their life cycle.

The need for such a systematic unification of scientific knowledge in various fields is due to the fact that: firstly, synergistic effects of a disproportionately large increase in the efficiency of synthesis of new knowledge from already known knowledge arise precisely at the junction of various areas of knowledge that intersect and can generate synergy in the process of obtaining new knowledge; secondly, the creation of competitive mining engineering products is possible only if the problems of these scientific and innovative projects are solved efficiently and with high probability. The last statement based on following example.
2. Results and discussion

In order to create a model of mining engineering that is competitive on the global market, the following external problems of a scientific and innovative project must be solved: identification and search for sources of financing for the project, search for venture investors and business angels (included in finance and credit); determination of the target market segment – market capacity (included in the scientific direction of marketing); to provide access to the necessary technologies for the creation and design of samples of mining engineering in conditions of sanctions and international tension (included in the scope of international scientific and technical cooperation); to predict the likelihood of the appearance of substitute products for the mining products under consideration (refers to the theory of global competition) solve issues of support (mentoring) of the project by state authorities and other entities that influence the scientific and innovative process (relates to the field of public-private partnerships); creation of a coalition of contractors, subcontractors of the project; to form a marketing policy of the organization (marketing); selection of an advertising agency and other issues of a scientific and innovative project.

At the same time and in parallel with this, ensuring the competitiveness of mining engineering products on the global market, is necessary to solve the following internal problems for this project: the formation of a project team with functional completeness and the necessary level of competence (relates to the field of human resources management of organizations); development of the information base and computer-aided design systems for mining engineering samples (the direction is automated information processing and management systems); to correctly determine the appearance – the structure and essential characteristics of the innovation project (system analysis and synthesis); choose the right materials for parts and components of the mining engineering facility (materials science and organization economics); to develop an attractive appearance of mining engineering products [refers to the field of design]; correctly solve the problems of the location of the governing bodies of the mining engineering [relates to psychology and ergonomics]; to formulate the concept of lean production in relation to this object of mining engineering and more.

It is not difficult to note that these external and/or internal solutions to the project are largely interdependent. For example, when searching for sources of financing, venture capital investors and/or business angels, a vital role is played by the key characteristics of the developed object of mining engineering, the estimated market capacity. In turn, for example, to determine the market capacity, it is necessary to determine the level of competitiveness of the mining engineering facility. At the same time, the level of competitiveness of the mining engineering object is formed by its functions, appearance, ease of location of governing bodies (ergonomics) and other characteristics determined by specialists from various branches of science and technology.

Thus, there is the reason to say that there is an absolute contradiction between the increasing differentiation of scientific areas [due to the complication of scientific and technological progress) and the lack of a tendency for the integration of scientific areas adequately expressed in science, necessary for the design of competitive models of mining engineering.

It should be noted that the processes of increasing customer satisfaction (users, operating organizations) and the process of increasing dissatisfaction are two different processes. Moreover, the lack of some qualities of a model of mining engineering cannot be compensated for a specific excess of other positive qualities of a technical example of mining engineering.

At the junction of the various areas of work, the project team creates and practically uses implicit knowledge by the project participants, which cannot be adequately described separately within the framework of the conceptual framework of each of some scientific regions. However, this knowledge at the junction of the properties of the object of mechanical engineering and the corresponding scientific disciplines is essential from the possibility of creating a synergistic effect due to the systematic combination (aggregation) of elements and components of mining engineering products in the object.

The scientific platform proposed in this work in mining engineering is designed to solve the problem of meaningful and controlled integration of scientific knowledge necessary for the design of competitive samples of mining engineering.
From the epistemological point of view, machineology can be considered as a way of understanding the realities of mining engineering within the framework of the functions of this scientific discipline. At the same time, the role of mining machineology guide researchers towards the correct setting of research objectives and forecasting the results of scientific research and innovation in mining engineering.

The practical importance of mining machineology is that its development allows practitioners to facilitate the search for scientific knowledge necessary for the design of mining engineering objects, and therefore increase the share of scientific results, inventions and other things used in practice.

From the occupation in the scientific space (positioning), mining machineology can be attributed to the object directly in modern science. The object (product) of mining machineology is complexes and objects in mining engineering. On this basis, mining machineology can be considered a product-oriented, and not subject-oriented (such as physics) scientific discipline. Such an orientation of mining machineology to a specific product (an object of mining engineering) can contribute to increasing the socio-economic efficiency of scientific research and innovation in the field of mining engineering. Thus, the development of mining engineering and the creation on its basis of a scientific platform can provide a kind of “coefficient of performance” of science and innovation in the field of mining engineering.

The development of mining machineology can be more successful if it is combined with a more active introduction of a project (product) approach in science and innovation and the creation of design teams and matrix organizational structures at enterprises engaged in experimental design work.

Mining engineering can serve as a conceptual methodological basis for a scientific platform in mining machineology, performing functions (methodological, cognitive, instrumental, legislative, optimization, prognostic, preventive, psychological, socialization of knowledge, risk reduction, system-forming), which can be determined by analogy with work [14]. For example, the methodological function of mining machineology consists in the formation of a conceptual apparatus, theoretical foundations of scientific research and a methodology for studying phenomena and processes, the formulation of laws and categories of mining machineology, the development of management tools for scientific research, innovative projects, and the product life cycle in the interest of increasing the efficiency of products of mechanical engineering, reduction of damage from industrial risks and the synthesis of an effective policy (system of measures) in the field of mining machinery triplets, innovations, technologies.

The cognitive function of mining machineology covers the processes of accumulation, description, studying the facts of reality in mining engineering, innovation, technology, analysis of specific facts and processes in the course of scientific research, the implementation of innovative projects, the life cycle of mining engineering products, identifying the most critical problems and sources of development of mining engineering, substantiation of individual measures and development programs of such engineering and other functions.

Mining machineology is also characterized by a regulatory (instrumental) function, which has a practical focus and consists in: synthesis of tools and methods for managing scientific research and innovative projects, the life cycle of technologies and products of mining engineering; the formulation of practical recommendations for authorities, research and development and experimental design work and the organizations that carry them out, real production facilities; predictive assessment of the effectiveness of research, development, production and operation, modernization and disposal of products and services.

The legislative function of mining machineology is manifested in the course of substantiating the need and developing certain legislative norms that are aimed at developing and regulating scientific research, innovation at all stages of the life cycle of products and services and other functions related to legislative activity.

Mining machineology also has an optimization function, which consists of the formation and/or selection of the best tools from the standpoint of a specific criterion, methods for implementing not only individual stages but the entire life cycle of products and services in mining engineering.

The prognostic function of mining machineology includes an assessment of the state of mechanical engineering in this sector of the economy and society in the future from the possibility of developing
specific areas of science, technology, technology, and reducing dangerous levels when conducting scientific research in mechanical engineering.

The preventive function of mining machineology is implemented in the implementation of proactive and preventive measures based on the forecast of the development of mining engineering, taking into account the possibility of the development of technical, economic and environmental crises, technological disasters, technological crises and other types of negative phenomena.

Mining machineology also has a psychological function, which is to explain to society the need for financial and other costs for the constant development of scientific and innovative activities, accelerating scientific and technological progress in the field of racing mechanical engineering.

The function of socializing knowledge in mining machineology is to disseminate knowledge about the role and importance of modern racing machineology, technology, technology for the modern state and society, the need for effective measures to develop science, technology, and models of mining mechanical engineering in society. Mining machineology is also characterized by a system-forming function, which finds expression in the accumulation of knowledge intended for designing adequate systems for managing scientific and innovative processes, including planning, organizing, motivating and monitoring the results of scientific and innovative processes in mechanical engineering.

The roles of mining machineology can be called: firstly, increasing the degree of coordination and optimization of scientific and innovative projects and processes in mining engineering; secondly, increasing the level of use of the results of scientific research and the implementation of innovative projects; thirdly, reducing the risks of unsuccessful research and innovative projects; fourthly, the growth of technical and economic results of scientific and innovative activities in the driving industry.

The following laws of mining machineology can be indicated: increasing the level of complexity of practical activities in mining and mining engineering leads to a complication of scientific and innovative processes in this area; in connection with the acceleration of the aging of scientific knowledge and the moral aging of mining engineering products, there is an increasing need to increase the effectiveness of scientific and innovative activities based on the development of mining machineology; due to the shortening of the development and implementation of new innovative projects in mining engineering, the need for an integrative function of mining machineology is growing; the growing need for the development of mining machineology is associated with the complexity of scientific and innovative projects; there is an increase in the role of mining machineology as the complexity of processes in mining engineering and other laws.

3. Conclusion
Positive effects during the implementation of innovative projects in mining engineering during the development of the scientific platform of mining engineering can arise due to: systematic integration of knowledge from various fields (technology, economics, marketing, management, innovation), which can generate a synergistic effect; reducing the risks of insufficient scientific support for the innovation project to achieve its positive results; higher object orientation of scientific research in mining engineering; increasing the likelihood of timely search and use necessary to solve the problems of an innovative knowledge project; determining the most relevant areas of scientific research in the driving industry; increasing the level of customer focus in scientific support in mining engineering; development of a product approach (product-innovative project) in mining machineology and other positive effects. This can lead to an increase in the profitability of innovative projects:

\[ D = A \times M \times K_p \]

where \( D \) – income from an innovative project in mining engineering;
\( A \) – volume of resources advanced [invested] in an innovative project;
\( M \) – innovative money multiplier (increase) in mining engineering [15];
\( K_p \) – coefficient (more than 1) reflecting an increase in the effectiveness of scientific support for an innovative project.
The work develops the fundamentals of mining engineering as a methodological basis for the formation of a scientific platform in mining engineering, proposes a model to assess the impact of the development of a scientific platform on the financial result of an innovative project in mining.

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