Problems of Innovation and Technological Development of Mining Enterprises of the Arctic Zone of the Russian Federation

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Abstract. It is shown that when implementing Industry 4.0 technological concept development in the Russian economy and changing the structure of industrial production it is necessary to increase the efficiency of the Arctic mining enterprises what determines the need for their technological modernization. The analysis of activities of thirty-two mining enterprises operating in the Arctic zone of the Russian Federation by implementation of innovation projects was carried out and it is shown that only a third of enterprises in 2013-2019 introduced technological innovations. To stimulate an innovation activity of enterprises it is proposed to include the possibility of “quasi-self-financing” of industrial production into the system of public-private partnership. To assess the economic feasibility of technological modernization of enterprises and accordingly to develop a strategy for innovation development it is proposed to use the developed methodology of investment and innovation analysis as a new direction of economic analysis of production systems.

1. Introduction

Due to the development of mining production regions currently receive a significant share of the gross regional product (GRP) from mining [1, 2] but due to the urgent need to move the Russian economy away from raw materials dependence and the implementation of the Industry 4.0 concept in the future the main attention will be paid to the development of the processing industry which is represented mainly by the primary processing of ore raw materials in enrichment and metallurgical processing in the Arctic zone of the Russian Federation. Accordingly, in these conditions it is necessary to increase the efficiency of mining enterprises, that is, to increase the share of value added in the value of products and a corresponding increase in its profitability. It is possible, first, by reducing the cost of material resources which will reduce the influence of production on the sensitive Arctic environment by industrial waste [3, 4]. Second, due to a significant increase of the labor productivity level thus in difficult living conditions of the Arctic population it is become more difficult to attract qualified personnel from other regions of the country for a work despite higher wages [5, 6]. Both of these problems can only be solved during modernization of existing production on a new technological basis, automation of production processes and their digitalization, that is, the development and
implementation of new production technologies using high-performance machines and equipment [7, 8].

However, this raises two questions. First, enterprises must understand the economic feasibility of technological renewal of their production and be able to calculate its economic efficiency, but unfortunately use of the methodology for assessing the effectiveness of the investment projects implementation to existing production does not allow to do this [9,10]. Accordingly, the management of enterprises cannot develop an effective strategy for the further innovation and technological development of its production. Second, it is need to know the current level of innovation activity of mining enterprises since the nature of the necessary further decisions not only of enterprises but also of the authorities to stimulate technological modernization using various measures, mainly of a financial nature depends on it. The solution of these problems is the aim of the work.

2. Materials and methods
The management of any enterprise should be interested in improving production efficiency, but the current methodology for its assessment is in the process of conducting traditional economic analysis ultimately comes down to calculating the values of the resource (material efficiency (ME), capital efficiency (CE), labor productivity (LP)) and overall economic efficiency (various indicators of profitability - products, sales, assets and equity capital). Further on this basis possible reserves for the further efficiency improvement are determined but not in a systematic way, options for increasing material efficiency, capital productivity and labor productivity are considered separately. Accordingly, subsequent management decisions on the implementation of measures to increase the level of values of the considered indicators cannot comprehensively cover the problem of increasing the economic efficiency of production.

A new direction of economic analysis of production systems is a system investment and innovation analysis [11]. It is based on the fact that there is a close cause and effect relationship between the technical, technological and economic aspects of the production systems development (enterprises, industries) which is expressed in the fact that a change of the technological renewal level of production determines the values of not only one of the three most important indicators resource efficiency (ME, CE and LP) but also the simultaneous change of the values of all three of these indicators. Such dependence is analytically expresses in the change of the coefficient of technology production level (K\textsubscript{ptl}) as the ratio of the material efficiency value to the capital efficiency value. Accordingly, the increase of its value is determined by the degree of renewal of the active part of the fixed assets of enterprises, that is, machines, equipment and vehicles [12]. The life cycle of production technology showing how the renewal of fixed assets affects the levels of values of indicators ME, CE and LP was developed [13]. The cycle consists of six stages but only one stage of technology development corresponds to the simultaneous increase of values K\textsubscript{ptl}, ME and CE.

Thus the aim of the management of any production enterprise including mining is to analyse trends in values of these three indicators over a long retrospective period of time (three to five years or more). Based on its results management decisions are made to improve the existing production technology or to switch to a new technology. At the same time economic calculations to determine not only the need for technological changes but also the time period for the introduction of technological innovations as well as the ability of enterprises to self-finance the implementation of relevant investment projects are carried out.

3. Results and discussion
The analysis of the development and implementation of innovation projects at thirteen mining enterprises of ferrous and non-ferrous metallurgy, chemical, diamond and coal mining industries operating in the regions of the Arctic zone of the Russian Federation for the period 2013-2019 was carried out according to their annual reports presented on the official websites and information contained in articles of leading Russian journals of the corresponding theme: "Gornyi Zhurnal", "Tsvetnye Metally", "Obogashchenie Rud", "Mining informational and analytical bulletin", "Gornyi Zhurnal", "Tsvetnye Metally", "Obogashchenie Rud", "Mining informational and analytical bulletin"
"Nonferrous Metallurgy", "Gold and technology", "Zolotodobycha", "Russian Mining Industry", "Chernye Metally". During the period only five enterprises (39%) implemented technological innovations [14-16] but most of them were aimed not at increasing the completeness and degree of extraction of useful components from mineral raw materials but at improving the processes of its transportation and ore preparation for further enrichment allowing to increase the volume of ore raw materials extraction and reduce costs for these processes [17, 18].

Thus results of the analysis show that until now the level of innovation activity of mining enterprises operating in the Arctic regions remains very low that is most enterprises are not engaged in innovation and technological modernization of production with the implementation of new technologies for processing raw materials. Unfortunately, an effective system for stimulating innovation activity of industrial enterprises in the Russian economy has not yet been created although the Federal Law "On Industrial Policy in the Russian Federation" adopted in 2014 assumes this system. At the same time the majority of Arctic industrial enterprises do not have their own financial resources for technological modernization [19] and interest rates on loans from commercial banks are still quite high. In such conditions in order to financially support the innovation activity of enterprises a system of public-private partnership should be developed where one of the elements may be "quasi-self-financing" of innovation production. It implies an increase in self-financing of technological innovations by leaving to enterprises a part of taxes on profit and added value which volume significantly increases with a decrease of a material consumption of production due to the effect of innovation tax leverage [20]. At the same time use of the investment and innovation analysis methodology in the practical activities of the economic services of enterprises makes it possible to develop a strategy of innovation and technological development with the calculation of all necessary economic and financial indicators in all possible options of implementation of new technologies and choice of the best option.

4. Conclusion

- The level of innovation activity of most mining enterprises operating in Arctic regions in the use of technological innovations is extremely low especially when technologies are implemented that increase the completeness of extraction of useful components from raw materials. Accordingly, in the near future without technological modernization no significant increase of the industrial production efficiency is expected.
- The economic substantiation of the prospects of the technological modernization of mining enterprises with the development of a strategy of innovation and technological development is possible using the methodology of investment and innovation analysis as a new direction of economic analysis of the activities of production systems.
- There is still no system for stimulating innovation activity of industrial enterprises in Russia therefore it is proposed to develop a system of public-private partnership where one of the elements may be "quasi-self-financing" for the implementation of new production technologies.

5. References

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