Innovation Development of Mining Enterprises in the Arctic Territory of Canada

V A Tsukerman¹, A A Kozlov¹

¹Luzin Institute for Economic Studies, IES KSC RAS Fersmana str. 24a, Apatity 184209, Russia

E-mail: tsukerman@iep.kolasc.net.ru

Abstract. The work considers the experience of innovation development of mining enterprises in the Arctic territory of Canada. For the innovation development of mining enterprises in the Arctic territory of Canada appropriate support mechanisms were created. The government of the country created a specialized organization, the Canadian Northern Economic Development Agency, acting as the main coordinator and investor of the innovation development of Arctic mining enterprises. The Yukon University which offers training of professional personnel and the development of innovation technologies and projects for mining enterprises was established. Specialized service companies are involved to improve the level of technical and technological development of mining enterprises. Mining enterprises interact with indigenous peoples through long-term agreements aimed at increasing their socio-economic well-being and creating new highly paid jobs. Taking into account the similar climatic and demographic conditions the experience of the Arctic territory of Canada is recommended to be used to increase the innovation activity of mining enterprises in the Arctic zone of the Russian Federation.

1. Introduction

The innovation development of industry is one of the main factors for the sustainable economic growth of countries and increasing their competitiveness. The development of mining enterprises in the Arctic territory of Canada is taking place in a harsh climate, low population density and underdeveloped infrastructure. Canada has made some progress in the innovation development of Arctic mining enterprises and this experience can be used for the Arctic zone of the Russian Federation [1].

2. Arctic territory of Canada

Canada has vast territories and waters beyond the Arctic Circle. As a rule the Arctic territories are understood as a part of the country consisting of three territories - Yukon, Nunavut and Northwest [2,3]. The area of the Arctic territories of Canada is 3,496,285 square kilometers which is about 35% of the country and in 2020 they were home to a little more than 126.6 thousand people which is 0.3% of the country’s population [4]. At the same time a significant part of the population of the Arctic territory is represented by indigenous peoples leading a traditional way of life. The extremely low population density causes many socio-economic problems of the macroregion, the main of which are: underdeveloped infrastructure, low availability of basic social services and high cost of living.

Table 1 shows the contribution of various sectors of economic activity to the regional gross product of the Arctic territories of Canada [5].
Table 1. The share of the sector of economic activity in the regional gross product of the Arctic territories of Canada (%).

| Sector of economic activity | Nunavut | Yukon | Northwest Territories |
|----------------------------|---------|-------|-----------------------|
| Public administration      | 19.5    | 23.0  | 14.5                  |
| Mining                     | 17.5    | 11.6  | 22.9                  |
| Building                   | 13.5    | 8.5   | 14.1                  |
| Real estate and rent       | 11.9    | 14.3  | 7.7                   |
| Education                  | 8.3     | 5.7   | 4.3                   |
| Health care and social assistance | 5.9 | 8.2  | 6.0                   |
| Retail                     | 3.9     | 5.1   | 4.8                   |
| Utilities                  | 2.8     | 1.9   | 1.2                   |
| Administrative and support services, waste management services | 2.4 | 1.4 | 1.7 |
| Media and culture          | 2.4     | 2.9   | 2.1                   |
| Transport and storage      | 2.4     | 3.2   | 7.5                   |
| Finance and insurance      | 2.1     | 3.6   | 2.9                   |
| Wholesale                  | 1.9     | 1.4   | 3.4                   |
| Other                      | 5.5     | 9.2   | 6.9                   |

The main sector for the Arctic territory of Canada is mining and its dynamic and intensive development primarily due to an increase of the level of innovation activity is the most important requirement for a stable socio-economic position of the entire macroregion.

3. Mechanisms of innovation development of the mining industry in the Arctic territory of Canada

The innovativeness of the development of the mining industry in the Arctic territories of Canada is determined by the following main factors. First, it is the general trend of the Canadian mining industry towards the efficient development and implementation of innovation technologies. Since 2019 the Canadian Minerals and Metals Plan is issued annually outlining the vision, principles and strategic directions that governments, businesses and stakeholders must follow to improve the competitiveness of the industry. The 2020-2021 plan declares that the use of the latest achievements in science, technology and innovation is of great importance for the competitiveness of the mining industry in Canada [6]. Second, the climatic, geographic and demographic conditions of the Arctic territory require the use of material and energy-saving technologies that allow to have a positive economic effect from the development of deposits. Third, the peculiarity of the introduction of any industrial activity in the Arctic territory is compliance with strict environmental safety requirements which requires the use of innovation developments [7]. Thus, in the document defining the foreign and domestic policy of Canada in the Arctic "Canada's Northern Strategy: Our North, Our Heritage, Our Future" one of the priorities for the development of the Arctic territories declared environmental protection and adaptation to climate change. At the same time, strict legal requirements aimed at preserving the vulnerable environment in the Arctic have led to an actual freeze of hydrocarbon production and a moratorium on exploration and drilling on the Arctic shelf. Such situation makes it impossible for large oil companies with the most modern innovation technologies in their sphere to operate in the Arctic territory, prevents the formation of large industrial clusters and the inflow of highly qualified personnel.

The main government agency that stimulates the innovation development of mining enterprises in the Arctic is the Canadian Northern Economic Development Agency (CanNor). Created in 2009 to promote long-term and sustainable economic development in the Yukon, Nunavut and Northwest
Territories it helps commercialize innovation technologies and improve the competitiveness of regional companies [8]. As part of its activities CanNor implements the Inclusive Diversification and Economic Advancement in the North (IDEANorth) program for the economic development of the Arctic territories. Within the framework of the program its participants have the opportunity to receive government funding for projects for educational programs, geological and geophysical research and other projects related to the extraction of minerals.

Over the past decades mining enterprises have expanded their use of outsourcing [9]. Theoretical studies suggest that a mining company needs only two “key competencies” to function and that all other activities can be outsourced. For example, a mining enterprise may outsource exploration, mine planning, industrial process design, raw material processing operations and all support functions while retaining only financing and management within the company [10].

The advantages of using industrial outsourcing lie not only in reducing operating costs but also in increasing the productivity and efficiency of production processes, hiring the appropriate highly qualified specialists and introducing the newest technologies [11].

Among the industrial outsourcing companies of the Arctic territories of Canada one can note the Groundtruth Exploration from Yukon which developed innovation exploration technologies that are not only more efficient than traditional ones but are also more environmentally friendly.

A feature of the functioning of the mining enterprises of the Arctic territory is their interaction with the indigenous population, consisting of the Athabaskan, Inuit and Gwich'in tribes. The Athabaskan and Gwich'in peoples live in Canada primarily in the Northwest Territories and the Yukon. Inuit live in Canada in 53 communities across virtually the entire Arctic territory of the country. Mining industry is the largest employer in the Arctic and the proximity of aboriginal communities to mines as well as a growing young indigenous population can help meet labor demand. Mining enterprises are implementing a range of educational initiatives such as specialized schooling programs, scholarships and literacy programs that contribute to the creation and development of human potential among indigenous peoples [12].

In the Arctic territory of Canada a system of agreements between large mining companies seeking access to the extraction of mineral resources and indigenous communities was developed [13]. Currently 40 such agreements was concluded [14]. Under these agreements mining enterprises are taking on a number of commitments to improve the environmental indicators of their operations. Separately the agreement stipulates the actions of the mining enterprises after their closure and the future plan for the reclamation of the affected lands. This state of affairs led to active efforts of mining enterprises to search for innovation technologies that help minimize industrial waste, preserve water purity, restore landscapes, etc.

The Yukon University in Whitehorse has been established and is functioning to promote the innovation development of mining enterprises in the Arctic territories of Canada.

With assistance of the Yukon University the Center for Northern Innovation in Mining has been established. The Center provides vocational training services and meet the need of local mining industry for skilled workers. Students are offered a wide range of relevant industrial and construction educational programs for using a staff of qualified teachers with many years of practical experience, modern equipment, mobile classrooms and high-tech simulators. Students can qualify for a driller assistant, heavy equipment technician, mining worker and more.

Also, the Yukon Research Center works effectively where one of the research areas is the formation of new science-based approaches to the development and operation of mines and the environmental assessment of their functioning.

The activities of the Center for Innovations and the Research Center create a link between research and industry thereby facilitating the implementation of innovation developments related to mining. This coordinated and holistic approach is addressed to solve specific challenges and realize opportunities in the Arctic territories of Canada mining industry making it more sustainable, environmentally oriented and innovative [15].
4. Conclusion
For the innovation development of mining enterprises in the Arctic territory of Canada appropriate support mechanisms have been created. In this regard the following points are of certain interest.

The government of the country created a specialized organization, the Canadian Northern Economic Development Agency, which acts as the main coordinator and investor of the innovation development of Arctic mining enterprises.

Creation in the city of Whitehorse the Yukon University which is directly in the Arctic territory of Canada and offering in its two Centers not only the training of professional personnel but also the development of innovation technologies and projects for mining enterprises.

Attraction of specialized service companies to improve the level of technical and technological development of mining enterprises.

Interaction of mining enterprises with indigenous peoples through long-term agreements aimed at increasing their socio-economic well-being and creating new high-paying jobs as well as strict adherence to environmental requirements, minimization of production waste and land reclamation.

Considered experience of the Arctic territory of Canada is recommended to be used to increase the innovation activity of mining enterprises in the Arctic zone of the Russian Federation.

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