Foreign Experience of Innovation Development of the Mining Industry in the Northern and Arctic Countries

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 sectors of the Arctic foreign countries. Arctic countries have created quite closely linked innovation systems in which the development of infrastructure as well as investments in human capital form and maintain high levels of innovation development of mining sectors. Study and systematization of the relevant foreign experience can become the basis for the development of a state regulation strategy of innovation development of mining sectors in the Arctic zone of the Russian Federation.

1. Introduction
Innovation development of mining sectors of the Arctic zone of the Russian Federation requires appropriate state regulation. When developing a strategy of such regulation it is necessary to study the relevant foreign experience.

Successful innovation development of the Arctic mining sectors of foreign countries is based on effective government regulation that takes into account scientific, technological, natural, spiritual, cultural, socio-economic and other territorial features.

At the same time the foreign experience shows that the basis for a high level of innovation development of mining sectors is not only the provision of natural resources but investments in human capital and innovation infrastructure.

2. Norway
The Arctic territory of Norway has both offshore and onshore mineral deposits primarily in the provinces of Finnmark, Troms and Nordland.

The mining industry operates in Bjørnevatne of the Sør-Varanger commune, on the Stjerneia island, in the Alta and Tan communes. Iron-bearing ores, nepheline syenite, altinsky slate and quartzite are mined in these territories.

The main principles of innovation development of mining sectors in the Arctic territory of Norway are set out in the "Strategy of the Government of Norway in the northern regions" [1] and "Arctic strategy of Norway - between geopolitics and social development" [2].

The main goal of these strategies is the development of an innovation economy in the Arctic territories of the country, transition from an extensive use of non-renewable natural resources to a rational management.
Great importance is attached to infrastructure. Thus in the National transport plan of the country for 2018-2029 most of the ongoing projects are being implemented in the north. Also the government has made efforts to expand access to reliable and efficient digital infrastructure.

Mining sectors of the Arctic territories of Norway have the necessary scientific and technical base for innovation development. For a long period, Norwegian mining enterprises show high innovation activity due to the use of both internal sources and intensive transfer of foreign technologies with much attention to the interaction of education and science. Universities of the country provide not only high-quality training and fundamental research but also contribute to the development and patenting of own inventions.

3. Canada
The Arctic zone of Canada occupies 40% of the entire sparsely populated territory of the country with the import of energy resources from the southern provinces. Exploitation and processing of mineral deposits is carried out mainly by large mining companies and mainly on a rotational basis. The main industries are the Elsa silver mine, the Minto copper mine and the Mine and Ekati diamond mines.

The principles of innovation development of mining sectors are presented in the government report "Northern Strategy of Canada: our North, our heritage, our future" [3].

For the innovation development of mining sectors of the Arctic territories the Canadian government actively supports the universities of country engaged in research in the sphere of industrial innovation.

To increase the efficiency of the implementation of innovation technologies and appropriate equipment for Russian mining enterprises it is possible to study the experience of small service companies which are widespread in Canada and cooperate with mining enterprises in the performance of geological exploration, mining and processing of ore, metallurgy, construction of buildings, structures and land reclamation [4]

In order to strengthen the support of economic activity in the Arctic territory of Canada the Agency for the Economic Development of the North was created. As a part of the agency's activities a feasibility study for the creation of an Innovation Center in the Arctic mining industry was developed. The Center conducts research on education, training, development and management models in the mining sector and options for financing industrial activities.

Creation and operation of innovation mining sectors is carried out by the "Scientific Research Council" created by the government. This agency contributes to the formation of competitive research and innovation activities at the local level, supports the leaders of scientific schools in the sphere of innovations, stimulates the emergence of new firms, export of products and investments.

4. USA (Alaska)
The US Arctic zone includes the state of Alaska which is the largest and least populous state in the country. Mining activities of Alaska are mainly associated with the production, transportation and processing of hydrocarbons. Also gold, platinum, chromium, mercury, silver, molybdenum, zinc, copper, lead and nickel are mined in the state. However, due to the geographic remoteness of deposits from other industrial centers of the country and expensive transportation the development of industrial sectors of the mining industry is rather slow.

In May 2013 the United States published a national strategy on the Arctic issues where the Arctic is recognized as the sphere of US interests the national security of the country depends on [5].

With regard to the innovation development of mining sectors in the Arctic the following can be noted. In the strategy one of the principles for the Arctic commitments and actions of the USA is use of innovation developments to support investment in research, meeting the demands of maritime transport infrastructure and other industrial needs in the Arctic.

Innovation development of industrial sectors in the Arctic territories of the United States is facing enormous difficulties. Due to geographical remoteness and the need to maintain a high standard of
living to maintain socio-political stability there is no effective development of the innovation system in Alaska. Only 2.5 percent of the received federal funding goes for investments in innovations [6].

5. Finland
Almost a third of the territory of the Finland is located in the Arctic. The development of the Arctic zone and its natural resources is becoming more relevant at the national and international levels and in various sectors of the economy. The principles of innovation development of mining sectors are set out in the "Strategy for the Arctic Region" adopted in 2013 [7].

In the Arctic part of Finland one of the largest gold mines in Europe in the Kittilä region is exploited and nickel ore at the Kevitsa deposit is mined.

Finland seeks to become a global pioneer in sustainable mining and this goal is supported by the government Funding Agency for Technology and Innovation, Tekes.

The development of mining sectors will require an increase of innovation activity. Recently a basic knowledge-intensive sector of the economy oriented on exporting products was formed. Technoparks are the main elements of the state innovation infrastructure and contribute to close cooperation between research university centers and industry and play a major role in the system of commercialization of the innovation developments of the country. The Finnish authorities considers the issue of the development of innovation activities both within the country and abroad as one of the main levers of increasing the competitiveness of domestic mining sectors.

6. Sweden
The Arctic zone of Sweden occupies about 22% of the area of the entire country and consists of the administrative region - Norrbotten county with the capital in Luleå. The population is approximately 3% of the total population of the country. The main economic activity is the mining industry. Rich deposits of copper, lead, zinc and large iron ore deposits are being exploited. Among them it can be noted the largest underground iron ore mine in the world - Kiruna and Aitik - largest copper mine in the Sweden.

Principles of innovation development of industrial sectors are set out in the "Regional development strategy for a sustainable future in Norrbotten 2020". The strategy was developed in broad cooperation with the Norrbotten Regional Council, representatives of municipalities, Luleå University of Technology and Sami Parliament [8].

The Strategy indicates the existing problems for the innovation development of mining sectors in the Arctic region of Sweden: population decline despite large investments in the economy of the region, age imbalance in the population in favor of the elderly, youth unemployment and a growing housing shortage. The further development of the mining industry of the Sweden is associated with improving infrastructure, creating a more competitive energy market and ensuring an efficient permitting process.

Innovation support of the development of mining sectors in the Arctic zone of Sweden is provided by the Technological University of Luleå dealing with research in a wide range of issues from planning and development of deposits to mining, mineral economics and gender studies in the mining industry. Also 60-70% of engineers working in the mines of the region are university graduates. The Hjalmar Lundbohm Research Center at the University of Technology is a prime example of a partnership between industry and science.

Also the Luleå University of Technology was appointed as the Nordic Mineral Research Coordinator for the NordMin project aimed to make mining and mineral sectors of the region more competitive and contribute to environmental, sustainable industrial growth.

7. Denmark (Greenland)
Greenland being the Arctic territory of Denmark and the largest island in the world has the status of a self-governing territory of the kingdom. Due to the special political structure of the island the municipal authorities strongly influence the strategic planning of the region development [9].
The Danish government subsidizes half to two-thirds of the budget of Greenland. Lack of the qualified personnel, peculiarities of the harsh climate, geographical remoteness of the island from the supply locations of and sales markets and the special sensitivity of the economy to the global situation do not contribute to the creation of large industrial sectors. For many years the state authorities of the country and the island have been taking upon themselves the issues of production and consumer services to solve urgent economic and social problems.

In the mining industry the current activity is mainly geological exploration although there are a number of projects approaching the operational stage for example the Kvanefield project for the extraction of rare earth metals and uranium ores [10].

The document defining the innovation development of mining sectors in Greenland is the "Strategy of the Kingdom of Denmark in the Arctic for 2011-2020", adopted in August 2011 [11]. The strategy provides supporting the activities of mining sectors exploiting mineral resources in Greenland rich in deposits of zinc, copper, nickel, gold, diamonds and platinum group metals. The island also has significant deposits of strategic metals, including rare earth elements.

The activity of mining sectors should be carried out on a social basis proving observation of the following principles:

- the society will receive a share of the profit from mining;
- the workforce and enterprises of Greenland are utilized to the fullest possible extent;
- All mining activities must be conducted in an appropriate way in terms of safety, health and environmental protection.

To support the innovation component of the mining sectors formation in Greenland the School of Mineral Resources functioning as a center of knowledge for the entire mining sector and training in the oil industry was established. The Greenland government is also implementing initiatives that use scientific research to train people. In particular, in cooperation with the United States of America a summer school was opened in Kangerlussuaq where foreign scientists teach secondary school students.

8. Conclusion

An analysis of foreign experience in the innovation development of Arctic mining sectors showed the fundamental possibility of achieving significant results in the development of scientific, educational, innovation and industrial activities, development of human capital, high economic growth and a favorable social environment in the Arctic territories. At the same time it should be noted that based on difference of industrial potentials of the Arctic subjects the state regulation of the innovation development of their mining sectors should not copy the institutional decisions of foreign Arctic countries but only take into account their experience and build their own territorially differentiated system of mechanisms and incentives for innovation development [12].

9. References

[1] Strategy of the Norwegian Government in the Northern Regions [Electronic resource] URL: https://www.regjeringen.no/globalassets/upload/ud/vedlegg/strategiru.pdf (last accessed: 02.09.2020)

[2] Norway’s Arctic Strategy – between geopolitics and social development [Electronic resource] URL: https://www.regjeringen.no/contentassets/fad46f0404e14b2a9b551ca7359e1000/arctic-strategy.pdf (last accessed: 02.09.2020)

[3] Canada’s Northern Strategy: Our North, Our Heritage, Our Future [Electronic resource] URL: http://library.arcticportal.org/1885/ (last accessed: 02.09.2020)

[4] Tsukerman V A, Kozlov A A 2018 Outsourcing Noncore Activities of Industrial Enterprises in the Arctic Zone of the Russian Federation Studies on Russian Economic Development 29(3) 252- 256

[5] National Strategy for the Arctic region [Electronic resource] URL: https://narfu.ru/aan/Encyclopedia_Arctic/Encyclopedia_USA_arctic_strategy%20 (last
Acknowledgment
Authors thank Ivanov Stanislav Victorovich for translation and help with preparation of materials.