The evaluation of the modernization cost of the transport infrastructure of the Northern Sea Route in the Arctic zone of the Russian Federation

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Abstract. The paper is aimed to figure out the cost of modernization of the transport infrastructure of the Northern Sea Route. Main unfavorable factors, such as fall in prices for energy resources and the necessity of the implementation of ecologically safe and energy efficient technologies are taken into account. It is estimated that the development of Northern Sea Route financial model should also reflect the effect of introduction of sanctions against the Russian Federation since 2014. The systematize the current conditions for the implementation of the, a survey of expert has been conducted. The total amount of cost appreciation, according to experts, is estimated from 50 to 70% of the base amount of planned investments in different areas. This result could be taken into account while making a proposals to potential investors.

1. Introduction

The problems of the development of Arctic transport communications are among the most important factors in the development of the Arctic zone (the Arctic zone of the Russian Federation, AZRF). The economic development of the Russian Arctic in the near future will be implementing within the 15 huge existing and promising projects, 11 of which are related to the development of oil and gas, 4 - ore and coal. Under these projects, a ramified transport infrastructure is being created - icebreaking fleet, transport and auxiliary vessels, port tugs. To support these projects, the maritime industry should be developed.

One of the main tasks is the development of the port infrastructure and the transport fleet of the Northern Sea Route (NSR). In September 2008, the "Fundamentals of the state policy of the Russian Federation in the Arctic for the period until 2020 and for the future" were approved [1]. According to the document, among the main national interests of Russia in the Arctic is the use of the Northern Sea Route as the national unified transport communication of the Russian Federation in the Arctic.

According to the "Strategy for the development of the Russian Arctic and ensuring national security for the period until 2020" [2], a so-called unified Arctic transport system (ATS) is planned to be created to address the development of transport communications of this territory. According to this document ATS will include the following elements:
The Northern Sea Route - a historically established national transport communication, which is the shortest sea route connecting the European part of Russia with the Far East; (NCR is located within the seas adjacent to the northern coast of Russia, as well as in the southern part of the Arctic Ocean within the exclusive economic zone of Russia in the Arctic, which extends 200 miles north of the extreme northern points of the coast and the islands of the RF [3]).

- a complex of vehicles of sea and river fleet, aviation, pipeline, railway and motor transport;
- a complex of coastal infrastructure, which includes: ports, navigation and hydrographic and hydrometeorological support facilities, communications accompanying transport activities in the AZRF, together with a system of meridian-oriented transport routes.

The combination of the Arctic's resource potential and the transport potential of the Northern Sea Route, capable of handling up to 150 million tons of cargo per year (about 5% of the world's freight traffic), while eliminating infrastructure restrictions, will allow the formation of a competitive regional marine system that will be the basis for ensuring national security in the Arctic [4].

The purpose of this study is to evaluate the cost of the modernization of the transport infrastructure of the Northern Sea Route the Arctic zone of the Russian Federation taking into account the main prospects and problems at the present stage. The study proceeds from the assumption that the prospects for building up the transport infrastructure of the Northern Sea Route depends a lot from the longitude of a sanctions regime against the Russian Federation and the backdrop of the oil and gas prices.

The research methods include a desk study and a qualitative study. An analysis of modern scientific literature and publications in the press was conducted with a view to establishing the current state of affairs in the project for the development of the transport infrastructure of the NSR. An interview was also conducted with a number of industry specialists, who were asked to answer a number of questions, in particular. Companies from which countries and in what amount would most likely be the main consumers of NSR transit services? Companies from which countries and in what volume could act as co-investors and in relation to which objects of investment? How much the project becomes more expensive to comply with modern environmental requirements? How much the potential financial results of the project are reduced by the sanctions regime.

2. The current state and prospects of the development of the NSR

The problems of the economic development of the Arctic are widely discussed at international conferences, in particular at the Conference on the Economic Development of the Arctic, an event of the business program of the 20th St. Petersburg International Economic Forum (June 2016) and at held regularly: “The Arctic: the present and the future (Aspol, St. Petersburg), "Arctic and offshore projects: prospects, innovations and development of regions” (Gubkin Russian State University of Oil and Gas, Moscow), "Development of oil and gas resources of the Russian shelf: the Arctic and the Far East" (ROOGD, LLC Gazprom VNIIGAZ, Moscow), "The Arctic: History and Modernity” (St. Petersburg Polytechnic University named after P. Veliky) and several others. The most important analytical materials were prepared by the authors' groups [5, 6, 7]. A number of key issues were highlighted in section of the journal Expert [8] and in a number of previously published works by one of the authors [8, 9, 10].

Today, climatic conditions (prolonged and harsh winters with short and cold summers) are the main obstacle to navigation for most of the year. Now NSR is considered as a complex infrastructure facility managed by the state, where carriers are provided with services to ensure safe conditions for navigation. It should be noted that the prospects for the development of the Northern Sea Route can be realized only with the normal functioning of the route that meets the requirements of the domestic regulatory framework and the norms of international law for the safety of navigation. It will be able to compete with the southern routes, provided it increases its economic attractiveness, when the infrastructure will allow to minimize the additional risk factors when swimming in Arctic ice. The development of the NSR as a single infrastructure transport facility is connected, first of all, with the
restoration of the basic ports throughout its entirety and with the need to improve all types of security and services - icebreaking, navigation and hydrographic, rescue, environmental, communications.

Development in the designated areas will make it possible to turn the NSR into a full-fledged modern maritime transport artery, through which cargo ships will travel year-round and regularly. The passage of vessels along the NSR is cheaper than the southern route (via Suez) - for fuel up to 20%, and shorter for up to 40% [11]. The exploitation of the northern route makes the cost of piracy less expensive, especially threatening the ships in the Gulf of Aden and increasing the insurance premiums in dozens of times. However, in the foreseeable future navigation in the Arctic waters will be possible only for a few summer months. In some areas, for example, between the islands of Wrangel and Novaya Zemlya (over 3,500 km), ice wiring is required. All this significantly reduces the speed of the transition (for example, the additional equipment of the vessel reduces its speed by 10-15%, and floating ice - by 2 times). In addition, the icing of ships reduces the useful load and increases fuel consumption. In connection with this, NSR uses mainly Russia for the implementation of "northern deliveries", transportation of raw materials mined in the northern regions and for some other purposes" [12].

As a result, it is the internal development of the Arctic region that should become the basis for building the logistics potential of the NSR, which is necessary to attract transit flows and related foreign investments. Industrial development of the Arctic involves the need for transshipment and transit of significant volumes of cargo and outstripping the development of transport and transport infrastructure. For the safety of the Arctic routes, a powerful network of hydrometeorological support is needed, large-scale aerospace and ice reconnaissance, naval expeditions and polar stations. The complex meteorological and ice conditions, a long polar night, the proximity of the pole, and shallow depths in coastal areas and approaches to ports, along with other factors, limit the functioning of maritime infrastructure in the area.

Currently, along the routes of the Northern Sea Route, about 2200 various navigation aids have been installed and serviced. Mostly these are visual (visual aids), the range of which does not exceed 15 miles and depends on the power of the light source, the height of the fire and the state of the atmosphere [13]. The existing navigational and hydrometeorological systems make it possible in general to provide economic activity in the western sector of the Arctic (the direction "Krasnoyarsk-Dudinka-Murmansk"). However, in the eastern sector, where most of the undiscovered potential resources are located, the transport and navigation infrastructure remains weak, regular navigation in the eastern sector of the NSR is almost not carried out [14].

For the functioning of the NSR at the moment the necessary regulatory and legal framework has been formed:

- A comprehensive project for the development of the Northern Sea Route with a period of implementation of 2015-2030 [6] was adopted.
- The Federal Law [15] came into effect, according to which the issuing of permits for navigation of vessels in the water area of the Northern Sea Route is entrusted to the Federal State Administration "Administration of the Northern Sea Route" [16];
- On April 12, 2013, the Ministry of Justice of the Russian Federation registered the Navigation Rules in the water area of the Northern Sea Route, where the amount of payment for icebreaking warships was determined [17].
- The decision of the Government of the Russian Federation [18, 19] was approved, which provides for the construction of 3 nuclear icebreakers with the commissioning of two of them in operation until 2020 (universal nuclear double-homing icebreakers of project 22220 (LK-60YA) with a capacity of 60 MW). The project is located at the LLC "Baltiysky Zavod - Shipbuilding", incl. Plant # 05706 (laid 05.11.13 - icebreaker "Arktika"), plant No. 05707 (icebreaker "Siberia" - metal cutting was started) and factory No. 05708 (the contract for the icebreaker "Ural" was signed). The total volume of investments is about 100 billion rubles;
- In August 2015, the "Integrated Project for the Development of the Northern Sea Route" was approved [20-22]. This project aims to increase the transit freight traffic on the NSR 20 times, and also
provides for the development of navigational and hydrographic support for the NSR, and the development of a draft icebreaker-leader with a capacity of 130 MW. Particular attention is paid to the preparedness of the oil spill response and emergency situations in the Arctic, to ensuring the safety of navigation; Northern delivery to the subjects of the Federation located in the Far North; Protection of the marine environment from pollution, the reliability of transit transport and transportation of hydrocarbon raw materials from production sites located on the Arctic coast and the continental shelf of the Russian Federation. A separate section identifies the component of the Ministry of Defense, the activities of ships and ships of the Navy.

The development of maritime transport communications in the Arctic is of strategic importance. Sea transport services can turn into the largest after the oil and gas raw material export. With a competent strategy of participating in international Arctic projects, Russia, positioning itself as a Eurasian maritime transport state, will be able to obtain a large source of revenue. In addition, it will be largely insured against the risks associated with the prospect of a worsening of the price situation on world hydrocarbon markets. It is important to remember that the full realization of the transport-transit potential has powerful multiplicative and complex-forming effects. The development of transport will positively affect the mobility of labor and living standards of the population, revitalize industrial and business activity, enhance international trade and take advantage of the maintenance and control of transit. "Russia must build an infrastructure that will facilitate shipping and bring profit" [23].

In the 1980s, with a strong state support, the volume of shipments for the NSR was more than 6 million tons, but already in the early 1990s it fell more than 4 times. In the last ten years, almost the same growth rates have been observed, but already under the conditions of market economic model of management. The volume of cargo carried by the Northern Sea Route has grown to almost 4 million tons in 2013-2014, including the share of transit cargo increased from 0.15 million tons to 1.36 million tons. In 2016 the traffic has overwhelmed the soviet period record (see figure 1).

![Figure 1. Freight traffic along the Northern Sea Route during the period 1981-2016, millions of tons (Atomflot)](image)

Some Russian experts predict a further steady growth in traffic, especially through transit in future – 2020 and so on. However, recently in 2014 transit cargo traffic decreased by 4 times compared to 2013. Many conclude that this happened due to the introduction of sanctions.

The development of the NSR has slowed down due to the economic crisis and the deterioration of political relations with Western countries, including with the member countries of the Arctic Council Canada, Norway, USA, Sweden, Finland since 2014. All this, coupled with the fall in world oil prices, led to the freezing of offshore hydrocarbon production projects, which are accounted for a large share of the freight traffic in the NSR.

One of the main tasks of the Arctic transport communications is the development of the port infrastructure and the transport fleet of the Northern Sea Route. The internal development of the Arctic region should become the basis for creating the logistics potential of the NSR, which is necessary to attract transit flows and associated foreign investments in the period until 2020. Subsequently (2020-2025 onwards), maritime transport services can become the largest after oil and gas raw materials
article of export. The optimal conditions for participation in international Arctic projects will allow Russia as an Eurasian maritime transport state to receive an important source of revenue.

Currently there is no question of serious competition with the Suez Canal: hundreds of ships pass through the canal for a day, while just about 70 vessels through the Northern Sea Route during the navigation season (6-8 months) for a year. The volume of transit through the Suez Canal in 2014 amounted to 963 million tons, through the NSR - 274 thousand tons.

According to Chinese forecasts, by 2020, the NSR will take from 5 to 15% of China's foreign trade cargo, mainly in the form of container shipments, that could support the volume of transit through the NSR at 8-12 million tons per year [24, 25]. Meanwhile, according to Atomflot, by 2020, the total volume of cargo transportation along the Northern Sea Route could reach 25-30 million tons.

In 2016, the Analytical Center under the Government of the Russian Federation was involved in the development of the conceptual framework for a competitive model for the development of the Northern Sea Route. By September 2016, the financial model was presented to the Japan Bank for International Development (JBIC), including a commercial proposal for potential investors with optimal financing scheme and marketing needs. However this proposal was not presented to the public. For the subsequent evaluation of the effectiveness of the project, it becomes necessary to expertly determine the necessary amounts of investments.

3. Results

The results of interviews with experts are presented in the table.

Table 1. The main parameters of investment in the development of the NSR, according to a qualitative study.

| №  | The main articles of investment                                | Estimation of basic amounts of investments, bln. Rub. (bln USD), terms and category of investment | Potential investor countries, an estimate of the amount in% of the base and the reasons for the rise in price |
|----|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| 1  | Port infrastructure and auxiliary vessels                     | 125 (2,5) in 2015-2020 50% - Russian oil and gas companies, 50% - foreign investors            | China, Japan, Taiwan, Germany, the Scandinavian countries. Rise in price - up to 50% (inflation, environmental requirements) |
|    | 1 - Icebreaking fleet - 3 icebreakers LK 60Ya (power 60 mW)  | 100 (2) in 2013-2025 Government funding 150-200 (3-4) in 2020-2030 Public-private partnership     | Rise in price - up to 70% (understated estimated cost)                                                    |
|    | - 2 icebreakers LK 110Ya (power up to 130 mW)                |                                                                                               |                                                                                                           |
| 2  | Transport fleet - gas carriers (deadweight up to 200 thousand tons) | 360 (7,2) – all private 20% - Russian oil and gas companies, up to 80% - foreign investors      | Korea, China, Japan, Taiwan Rise in price - up to 50% (inflation, environmental requirements)            |
|    | Equipping NSR with search and rescue, navigation, port, repair and logistics services | 180,8 (3,4) – all government funding. The attraction of private capital is possible                | Rise in price - up to 70% (understated estimated cost)                                                    |
| 3  | Cartography and others                                       | 10-50 (0,2-1,0) Government funding 925-1100 (19,5-22)                                          | Rise in price - up to 40% (understated estimated cost)                                                    |
|    | Total including:                                            |                                                                                               |                                                                                                           |
|    | Private investment                                           | 483-600 (9,6-12)                                                                             |                                                                                                           |
|    | Foreign investments                                          | 350 – 500 (7-10)                                                                             |                                                                                                           |
|    | Government funding or investments under public-private partnership | 450-500 (9-10)                                                                             |                                                                                                           |
Despite the fact that the Southeast Asian countries are considered as the main potential investors in the project, the sanctions regime will significantly influence their preferences in investing in this or other alternative international projects.

4. Discussion
According to experts, Russia does not have enough resources to provide international transit through the NSR. Those countries that are interested in transit are also viewed as potential investors. According to the calculations, it is necessary to reach agreements with a pool of investors, since it is necessary to attract unprecedented large sums. To implement such an international project, it is necessary to understand which parties and in what volumes will become the buyers of services and which parties will be able to allocate financial resources for the construction of the necessary infrastructure and vessels.

Under the sanctions regime, potential investors from many countries of the world are not ready to participate openly in the implementation of the project. The main questions occurs. Can such a project be successfully implemented in the absence of a favorable international environment? How does the potential financial impact of the project are reduced by the sanctions regime? In addition, some "third" countries, especially those applying for Arctic maritime logistics (China, Japan, South Korea, Germany, etc.), promote the idea of considering NSR as international waters. Moreover, some of them have already built research icebreakers and started hydrographic and climatic studies. In this situation, a compromise in territorial disputes in the Far North is possible only on the maximally mutually beneficial basis, which excludes the forceful solution of the problem, as well as economic pressure. For example, Finland links the prospects for the development of cooperation in the Arctic in many ways with the Russian Federation, which implies the active use of Finnish technological know-how in updating the infrastructure of the Russian-controlled NSR.

5. Conclusions
The number of unfavorable factors make the analysis of the prospects for building up the transport infrastructure of the NSR uncertain and highly dependent on these factors.

The total amount of cost appreciation, according to experts, can be from 50 to 70% of the base amount of planned investments in different areas. Changing the conditions, increasing the cost of the project and reducing its financial attractiveness can alienate potential investors, who are already insufficient in terms of sanctions. This result could be taken into account while making a proposals to potential investors.

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