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Current Trends and Problems of Development of the Arctic Marine Freight Traffic*

Vladimir Stepanovich SELIN
Doctor of Economics, Professor
G.P. Luzin Institute of Economic Problems of Kola Scientific Centre of RAS
24A, Fersman Street, Apatity, 184209, Russian Federation, silin@iep.kolasc.net.ru

Abstract. The article analyzes the trends and evaluates the prospects of functioning of the Northern Sea Route. It shows that after the change of its management model its freight traffic has dropped 4-fold, and in the Eastern sector (outside the Vilkitsky Strait) – 40-fold. In the recent years there has been a certain revival of transportation, including transit, which reached its maximum of 1.27 million tons in 2012. However, over the next two years they declined again; the drop was particularly significant in 2014 and amounted to a total of 240 thousand tons. The main problem is that this rather complex system is influenced by many factors, often contradictory and poorly predictable. Thus, the growing need for energy resources determines the overall need for developing the Arctic shelf. However, the possibility of climate cooling and the deterioration of ice situation can influence the possibility of transporting these resources. Besides, the Ukrainian crisis followed by the "war of sanctions" will cause a significant decline, especially in the medium term, the attractiveness of the European oil and gas market, which will cause the shift of strategic interests of Russian companies to the Asia-Pacific region. This necessitates the modernization of the Arctic transport and logistics system and introduction of new technical solutions. For instance, even nuclear-powered icebreakers series LA-60Ya that are currently under construction will not be able to escort linear tankers and gas carriers with a deadweight of more than 100 thousand tons along the eastern sector of the Northern Sea Route. It is necessary to create more powerful vessels of the classical type or to design new models. All these driving forces and constraints are not always predictable within the framework of standard economic and statistical approaches. In this regard, the study reflected in the article used expert approaches

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along with the methods of factor and economic analysis. The main result is a package of proposals for the support of the Arctic marine freight traffic.

Key words: Arctic, marine freight traffic, economy, resources, shelf, factors, icebreakers, climate, program.

The main objective of the study is to analyze trends and assess the prospects of development of sea communications of the Russian sector of the Arctic. Scientific novelty and relevance of the study is determined by the factor analysis applied by the author and by creating the model scenarios on this basis. The functioning of communications in the Arctic and their basic element – the Northern Sea Route – is described in the works of G. Evdokimov, S. Koz'menko, V. Mikhailichenko, A. Pilyasov and other domestic authors; however, there were no attempts to make comprehensive assessments over the last 5 years. It is hardly possible to highlight examples of serious foreign research in this sphere.

At the late 1990s, Russia's economy was ready for radical changes associated with the transition from the criterion of goal management to the criterion of economic efficiency. This transition had a dramatic impact on Arctic marine transportation: having reached their maximum in 1987 (about 6.5 million tons), they decreased to 1.6 million tons (fourfold) in 1999, while in the Eastern sector they decreased 40-fold (to 30 thousand tons). In the recent years there has been a gradual growth of freight traffic, including transit; but in general it clearly does not meet the geo-economic challenges and opportunities of the Russian Arctic.

Seven and a half million tons of crude oil were shipped in the Barents Sea due to the development of the Varandey field in 2010. A sharp decrease (to 3.9 million tons) occurred in 2011 due to the reduction of production at the Yuzhno-Khylchuyuskoye field. However, this sector was not included in the water area of the Northern Sea Route (NSR), although it remains a basic element of all the transportation. Until 2010, the NSR freight flows did not exceed two million tons, out of which over 80% were in the Kara Sea because they supported the activities of JSC Norilsk Nickel and exported oil and gas condensate from the Gulf of Ob.

Freight transportation along the Northern Sea Route in 2011 amounted to 3,111 thousand tons (according to the administration of the NSR), including [8]:

- export (806 thousand tons) – 26% of all the traffic;
- delivery (1,471 thousand tons) – 47.2% including inter-port traffic along the Northern Sea Route;
- transit (834 thousand tons) – 26.8% of all the traffic.

Freight traffic in 2011 in areas adjacent to the NSR and covered with ice for the period of more than six months (in accordance with Article 234 of the UN Convention on the Law of the Sea such areas are considered to be areas with special conditions of regulation), amounted to 3,900 thousand tons in the Pechora Sea (south-east of the Barents Sea), and 415.3 thousand tons in the northern part of the Bering Sea. The total traffic in the Arctic amounted to almost 7.5 million tons including transportation within the boundaries of the NSR (3,111 thousand tons) and adjacent areas (4,315 thousand tons).

It should be noted that transit along the Northern Sea Route is not regarded as traffic between foreign ports (there were no such traffic in 2011, in 2012 there was only one voyage). The majority of cargo flows were effected between the port of Murmansk and the ports of South-East Asia; besides, 14 voyages were made by vessels with a deadweight of more than 20 thousand tons, including 10 voyages by vessels with a deadweight of 70 thousand tons. The geography of the voyages was as follows:

• Murmansk – ports of China: 492.7 thousand tons;

• Murmansk – ports of South Korea: 231.0 thousand tons;

• Murmansk – Bangkok (Thailand): 90.3 thousand tons.

In 2012, transportation grew to almost 4 million tons, including the growth of transit from 0.8 to 1.2 million tons. Its structure will be presented in the next section.

In 2012, a growing trend of cargo traffic continued. If in 2011 thirty-four transit voyages were made and 834 thousand tons of cargo were transported, then in the following year these figures amounted to more than 1.27 million tons and 46 voyages, respectively. Main goods were still shipped from the port of Murmansk to the Asia-Pacific market with the following characteristics [8]:

1. China: import of gas condensate – 181 thousand tons;

• iron ore import – 262 thousand tons;

• exports of general cargo – 30 thousand tons;

2. South Korea:

• import of gas condensate – 303 thousand tons;

• export of aviation gasoline – 198 thousand tons;

3. Singapore: import of fuel oil – 45 thousand tons.

In 2012, in connection with the change in the situation on the European and especially North American markets, the first (in the full sense of the word) transit trip from the port of Hammerfest (Norway) to the port of Hangzhou (China) was made. It was made by the world's only ice-class LNG carrier *Ribera Del Duero Knutsen* with the load-carrying capacity of 173.4 thousand cubic meters.

However, in 2012, the maximum level of the so-called transit along the Northern Sea Route was reached. If in 2012, as was already mentioned, 46 voyages were made (1,270 thousand tons), then in 2013 – only 33 voyages (1,160 thousand tons) and in 2014 – 24 voyages (240 thousand tons) [12].

It should be noted that, in general, the volume of transportation in the water area of the Northern Sea Route was significantly greater – in 2012 it was about four million tons, including 1.5 million tons of oil export from the Gulf of Ob, about 0.6 million tons used to support the functioning of the Norilsk industrial region (including the provision of Kola MMC with matte), and the export of forest, coastal navigation, etc. Icebreaker *Krasin* (Far Eastern shipping company) was the only vessel that could escort 37 ships in the eastern sector of the NSR, these ships delivered 125 thousand tons and exported about 105 thousand tons of cargo, including the waste collected during the execution of the program for cleaning up the Arctic region.

Wood is widely exported to dozens of countries, its export geography is constant-ly expanding. The main importers are Bel-gium, Germany, the UK, Hungary, the Netherlands, France and other EU count-ries. Wood is also delivered to Turkey, Iran and some countries in the Asia-Pacific region. And although their total volume does not exceed 500 thousand tons and it is not commensurable with the amount of hydrocarbons, the volume of freight traffic along the NSR also amounts to hundreds of thousands of tons.

We consider as a separate issue the transportation in the Barents Sea that is included in the Arctic water areas, but not included in the NSR area. Thus, LUKOIL built a fixed offshore ice-resistant off-loading terminal (FOIROT) that has the throughput capacity of up to 12 million tons of oil per year. The marine terminal for the shipment of oil produced in the Timan-Pechora province is located in the village of Varandey in the Nenets Autonomous Okrug. Small shuttle tankers transport oil from Varandey to the coastal tanker *Belokamenka* in the port of Murmansk for further export. FOIROT was commissioned in 2008. The terminal operates year-round; icebreakers assist its work in winter [2].

The marine oil transportation system established in the Arctic has no analogues; besides the Varandey oil terminal it includes an oil gathering pipeline 158 km long, a coastal tank farm with the capacity of 325 thousand cubic meters, a pump station, power supply facilities, tanker and support fleet that consists of three shuttle tankers with the deadweight of 70 thousand tons, an icebreaker, a tug boat, an offshore transshipment complex with the capacity of 250 thousand tons, and a rotation village.

The shipment of oil from the terminal that started in 2008 reached a maximum of 7.7 million tons in 2009. After that the amount of production began to decline: in 2012 it dropped to 3.9 million tons, in 2013 – to 2.9 million tons. The production was supposed to rise again since 2014; however, preliminary data suggest that a level of about 3 million tons is maintained. The oil is shipped by shuttle tankers to coastal tankers in the Kola Bay and is then delivered to European customers [2].

A project for the development of the Prirazlomnoye field in the Pechora Sea was launched in 2005; for this purpose the country's first offshore ice-resistant oil platform (OIROP) was reconstructed at JSCo "PO "Sevmash" (city of Severodvinsk). Its installation on the field has been repeatedly delayed and was completed only in 2014. The maximum production under the project can reach 9–10 million tons in the next three years. The transport system is provided by OIROP. The data on oil transportation are given in the previous section.

The **Modern Commercial Fleet** (Sovkomflot) is the main Russian company specializing in maritime transportation in the Arctic. Today, one third of Sovkomflot vessels is represented by ice-class fleet, which is the largest, the most modern and technically advanced tanker fleet in the world. It is not surprising that the company has already established long-term cooperation with leading oil and gas companies like Gazprom and its subsidiaries, Exxon Mobil, Vitol, Glencore... [1]

Currently, Sovkomflot is the leading company that provides transit navigation along the Northern Sea Route, a promising marine path that significantly reduces the route from Europe to the countries in the Asia-Pacific region. Thus, in the period from 2010 to 2013, the company's vessels made seven trips between the ports of Europe and South-East Asia and transported 360 thousand tons of hydrocarbons and 67 thousand tons of iron ore concentrate.

In August 2010, a large-capacity Aframax ice-class Arc5 (ICE-1A Super) tanker SCF *Baltica* salied along the route Murmansk (Russia) – Ningbo (China). The tanker with the deadweight of 117 thousand tons was at the time the biggest vessel that ever worked in the Arctic region and it proved the possibility of large-capacity shipping along the Northern Sea Route. The duration of its voyage was 22 days, out of which 8.4 days – along the Northern Sea Route. The time saved on this route compared to the route through the Suez Canal amounted to 18 days.

In 2011, an even larger Suezmax ice-class Arc5 (ICE-1A Super) tanker *Vladimir Tikhonov* with the deadweight of 163 thousand tons passed through the high-latitude route north of the New Siberian Islands, having covered more than two thousand miles along the Northern Sea Route in only 7 days. The voyage from Murmansk (Russia) to Map Ta Phut (Thailand) lasted 28 days. The time saved was 8 days. That opened up an opportunity to use a new deep-water route suitable for deep-draft vessels that carry larger consignments. Thus, the feasibility of transit commercial shipping along the Northern Sea Route was confirmed [1].

In November 2013, an ice-class Ice-2 (1C) tanker *Viktor Bakaev* sailed westward along the Northern Sea Route during the period of intensive ice formation thus proving the possibility of navigation of large tankers of a lower ice class through the improvement of ice navigation tactics, namely, enhancement of interaction with escorting icebreakers and correct routing.

In 2013–2014 Sovkomflot built four gas tankers of a new Arc6 class for the project "Sakhalin LNG", and for the upcoming project "Yamal LNG" (2016). At the same time, OAO NOVATEK itself plans to place an order with Japanese and South Korean shipyards for the construction of ten Arctic LNG carriers for the transportation of liquefied gas from the Yamal Peninsula.

In accordance with the Strategy for development of the Arctic zone of the Russian Federation and provision of national security for the period up to 2020, one of the important tasks is to improve transport infrastructure in regions of the Arctic continental shelf in order to diversify the main routes of deliveries of Russian hydrocarbons to the world markets. It can be noted that fright turnover along the Northern Sea Route is one of the main characteristics of socio-economic development of Russia's Arctic.

The factor analysis of freight traffic along the Northern Sea Route shows that the influence of various forces is rather contradictory, especially in terms of forecasts of these factors for the near and distant future. Thus, according to experts, if the warming continues, then by 2020 the Arc7 class vessels (with ice-breaking capability of up to 1.5 m) will no longer need an icebreaker escort in the Kara Sea. Other forecasts predict the beginning of cooling in the next 5 years, which will restore the mode typical of the late 1990s when icebreaker escorting was necessary in the Kara Sea from December to May. Respectively, according to such forecasts, the thickness of the ice cover in the eastern sector of the NSR will vary from two to three meters; therefore, the requirements for icebreakers' capacity will change [9].

According to experts, navigation in the Arctic in recent years proves that under current climatic conditions the duration of voyages for cargo ships sailing to the ports of South-East Asia along the Northern Sea Route is by 7 to 22 days shorter compared to their sailing through the Suez Canal, which is an important economic advantage. The fee for icebreaker escorting of ships along the NSR (considering a new flexible tariff) can be equated to the fee for passage through the canal. An increased insurance when sailing along the Northern Sea Route due to the risk of the ship's being damaged by ice can be compared to the increased insurance during the passage of the Aden Strait (risk of encountering pirates). Additional costs of sailing along the NSR include expenditures on ice piloting, but they are not very large (about 10 thousand US dollars per voyage). On this basis, we can assume that a 10 days time-saving for a voyage is equivalent to reducing shipowner's expenses by 250 to 900 thousand US dollars per voyage, depending on the amount and type of cargo [4, 5, 8].

The above-mentioned failure in the transport system of the Northern Sea Route that occurred in the 1990s was determined by the transition of the national economic system from the principle of national expediency to the principle of economic efficiency. Accordingly, there was a sharp reduction in the state support of all elements of the NSR. The development of the transport system on the principles of efficiency requires large-scale growth of freight traffic. It can be facilitated, in our opinion, only by transportation of Arctic hydrocarbon resources.

In this regard it should be noted that, first, they currently make up more than half of all the traffic along the NSR, and at least 70% if we take into account the Barents Sea (which is not included in the water area of the NSR, but is part of the Arctic Sea). Second, in the future it will be determined by a quite rapidly growing demand for energy and a large-scale nature of this demand. In the global aspect it is associated with existing inequalities in the standard of living and, consequently, in the consumption of resources. For instance, members of the so-called Organization for Economic Cooperation and Development (OECD) that comprise a population of about 1.2 billion (15% of the world's population) consume 5.5 billion tons of primary energy (more than 45% of global consumption). Obviously, this inequality will be reducing and it will serve as a "locomotive" in the oil and gas markets [11].

In connection with the growth population and a trend of convergence in consumption levels, the demand for energy will continue to grow steadily. However, it will lag behind the growth of total revenues due to rapid changes in the efficiency of the use of resources, also as a result of the increase in prices for primary energy. The growth of prices is also manifest in the growing supply of unconventional energy resources. The more the economy is faced with price pressure and the greater the opportunities of alternatives, the more prominent is the role of technological change. The energy markets in this respect are no different from others. The only important difference is that energy is a quite inertial sector in which structural changes occur slowly. They are not immediately noticeable, and one of the reasons is the presence in the global energy sector of certain segments in which the activity of market segments and competition is very limited.

The situation in the global markets of hydrocarbon resources can be considered on the example of oil and liquefied natural gas. Natural gas was traditionally consi-dered to be an energy commodity for local consumption, and until 1990 it was transported exclusively via pipeline. A breakthrough took place in the early 1990s, when technologies of mass production of liquefied natural gas (LNG) and its delivery to consumers were mastered. The production of liquefied gas amounting to less than 10 million tons back in 1995, has reached 100 million tons by 2000, and in 2011, according to preliminary estimates, it can exceed 300 million tons. It means that currently it accounts for almost 15% of the global production of natural gas or more than 40% of total exports [6].

The Russian Federation produces about 12% of the world's oil and over 18% of natural gas. At the same time, the share of national oil sector in 2002 did not exceed 7% in the global export. It reached its peak in 2010 having exceeded 12% of world exports, which was much higher than Russia's share in global reserves. According to leading experts, it is likely that in the near future Russian oil production will begin to decline, even despite the active development of deposits in the Nenets Autonomous Okrug and the Pechora Sea. It should be noted that Arctic marine transportation of oil in the foreseeable future will take place only in the western sector of the NSR (Barents and Kara seas), and it is unlikely to exceed 40 million tons. They will be focused primarily on the European market as before.

This is determined by at least two factors. First, the Asia-Pacific market, which is more attractive in terms of its growth rates and the state of relations, will be impassable for 5–6 months in the eastern sector of the NSR even under the conditions of continued warming (optimistic option); passing will still require icebreaking support, and this poses serious problems for large tankers, as will be shown below. Second, the North American market until at least 2030 will not be interested in the hydrocarbons exported by Russia because the U.S. has its own sufficient reserves of shale oil. Besides, oil reserves in Canada – the U.S. nearest neighbor and ally – are three times greater than those of Russia. Canadian oil is heavy, most of it is bitumen, but technological progress quickly improves the effectiveness of development of such fields. Finally, we cannot forget the traditional "mistrust" of the North American market toward Russian products, the mistrust that has aggravated in the period of the "Ukrainian crisis".

The LNG market, which, in contrast to the "pipeline" gas market secured by long-term contracts, is largely determined by current stock prices. Its volatility proved especially noticeable during the economic crisis in 2009 and the "oil shale" fever in the U.S. when the price of liquefied natural gas dropped almost twofold. As for the geography of export deliveries of LNG, then up to 2000, about 90% of them were made to the Asia-Pacific market (APM), primarily to Japan and South Korea. Europe began to diversify its deliveries by liquefied natural gas in 2002, and its current consumption of LNG reaches 20% of the total consumption [11].

New facilities for the receiving and regasification of LNG were actively designed in virtually all global markets in the pre-crisis period (2007–2008). Their capacity by 2015 was to increase more than twice and provide the receiving of 450 million tons of liquefied natural gas. The relevant projects in Russia were actively worked out in that period.

Almost half of the terminals were supposed to enter into operation in the United States of America. In this respect Russia regarded the North American market as more preferable, because our country is actively engaged in the expansion of pipeline communications in the European market; and as for the Asia-Pacific market of LNG, the access to it is limited because of high transportation costs and economic risks at the transportation from Western Siberian fields, and especially from deposits in the Barents Sea.

However, the NAM gave all exporters an unpleasant surprise: due to a sharp rise in the shale gas extraction, the construction of new terminals for LNG imports in 2009–2010 was almost "frozen". It was done despite the fact that its calorific value is twice lower than that of natural gas, and it contains a considerable amount of harmful contaminants that do not allow it to be transported through high pressure pipeline without preliminary costly purification [3].

Nevertheless, the gas sold in the U.S. was the cheapest. In the first half of 2012 its price at the Henry Hub terminal amounted to 85 U.S. dollars per thousand cubic meters. Moreover, in certain periods it dropped to 70 US dollars thus significantly "exceeding" Russian domestic tariffs. According to Rosstat (Federal State Statistics Service of Russia), the average price at which Russian enterprises purchased gas in the same period was 3.5 thousand rubles (115 U.S. dollars) per thousand cubic meters [10]. In this connection, it is difficult to predict the potential export capacity of the NAM. As for the Pacific market, it is far off; and icebreaker escorting in the Arctic transport system is required almost all year round. But we shall talk more on the subject further.

Currently it is known that Gazprom has indefinitely postponed the Shtokman project and the construction of liquefied natural gas plants in the Yamal Peninsula (Kharasaveyskoye field). But there emerged a new ambitious and innovative project "Yamal LNG", which is being implemented by OAO NOVATEK, the largest independent and the second largest producer of natural gas in Russia. In the framework of this project it is planned to develop the South Tambey gas condensate field in the Yamal Peninsula and to build an LNG plant. It is planned to establish a seaport in the village of Sabetta on the eastern coast of the Peninsula in the Gulf of Ob.

The condition of the icebreaker fleet remains a separate strategic issue for Arctic cargo traffic. It consists of (state-owned) six nuclear and five diesel-electric icebreakers. However, by 2022, when the development of the Arctic shelf will enter its active phase, only half of them will have remained in commission. Given the fact that the latest nuclear icebreaker *50 Let Pobedy* was built almost 20 years under constant shortage of funds, we can see the gravity of the problem. At that, one should bear in mind that the cost of a dual-draft icebreaker can reach a billion US dollars and a leading linear icebreaker can cost 1–2 billion U.S. dollars.

Currently the Transport Strategy of the Russian Federation for the period up to 2030 envisages the construction of three multipurpose LA-60Ya-series icebreakers that will be able to provide escorting in the sea covered with ice of up to 2.8 m thick and in shallow areas in the estuary of the Yenisei and the Gulf of Ob, and in other coastal areas of Arctic seas. They are planned to replace the *Arktika* and

Taimyr-class icebreakers. Obviously, this will not be enough for year-round exports of products of the Arctic zone of the Russian Federation, if their volume reaches millions and tens of millions of tons. Currently advertised transit schemes are designed for the summer period (July – September) and are hardly suitable for mass production of LNG that requires the NSR be accessible all year round [7].

Another problem associated with ice navigation is the width of the ice channel. The existing *Arktika*-class icebreakers are capable of making it 33–34 meters wide including the crumpled ice at each side of the channel, while the width of the *Panamax*-class tankers reaches 40 meters (with the deadweight of up to 80 thousand tons), and the *Suezmax*-class tankers – 50 meters (deadweight of up to 200 thousand tons). By the way, this class includes the modern LNG carriers, the deadweight of which can reach 170 thousand tons.

The already mentioned LK-60Ya-series icebreakers will be capable of making an ice channel 37–38 meters wide, so an issue is raised concerning a new class of icebreakers – LK-110Ya – capable of moving through the ice up to 3.5 meters thick and to escort *Panamax*-class vessels in any ice conditions (ice channel 43–44 meters wide).

Theoretical and experimental studies of various methods of piloting large vessels in ice-infested waters suggest a new innovative technical solution (patent of the Russian Federation) for making wide channels (50 m or more) in the ice. Almost all large ships can safely move along such channels in almost any ice conditions, including ice compression. A traditional single-hulled icebreaker up to 50 m wide is characterized by greater ice resistance and, hence, greater power consumption. Therefore, one of the major challenges when creating a new type of vessel was to reduce its ice resistance [7].

The solution to this problem has been found in designing a new icebreaker that has a multihull structure bound together by a single platform. This icebreaker has three or four relatively small hulls, so that the total area of the hulls is considerably less than the width of the channel created by the icebreaker. The individual hulls of a multihull icebreaker do not overlap each other. The hulls are arranged in such a way that makes it easier for the side hulls to break the ice. Each of the side hulls breaks the ice into the channel made by the middle hull of the icebreaker. Research on the methods of escorting heavy-tonnage vessels show that the work of the hull to break the ice in the channel can reduce ice resistance by up to 40% compared with the movement of the hull in a continuous ice field. Thus, due to the special arrangement of the side hulls it has become possible to achieve additional ice resistance and thus reduce energy costs when making a wide channel.

The proposed technical solution has been thoroughly tested in the laboratories of Krylov State Research Center. Special attention was given to identifying the propulsion qualities in ice-infested waters and controllability of a new icebreaker, and to ensuring its ice resistance. Currently, a preliminary design of the new icebreaker is under way [7].

The beginning of offshore exploration, particularly given the likely changes in the climate, may lead to a rather optimistic scenario. It should be noted that transportation, as well as transit, in the eastern sector of the NSR is unlikely to increase considerably in the next 10 years. A more positive dynamics can be expected in 2025 and in a more remote perspective, especially if the opinions of experts concerning the significant warming and the change in the ice conditions in the Arctic are confirmed.

As we have already noted, according to the optimistic scenario, as the climate gets warmer, the ice cover in the Arctic will become smaller and thinner. Navigation will improve not only along sea routes, but also in the coastal area, along major rivers. More opportunities will arise for the development of water transport, trade and tourism. The Northern Sea Route can become one of the major global freight routes, and the decrease of ice coverage will promote the development of offshore oil and gas production. However, experts warn about new risks. A combination of factors such as rising sea level, thawing permafrost and the increasing impact of waves as a result of increase in the area of open water, will cause the increased erosion of shorelines in the Arctic. All this adversely influences the entire infrastructure, primarily, the port infrastructure [9].

Considering all these circumstances, the sufficiently contradictory results have been obtained through an expert survey, which was conducted in the course of the research-to-practice conference “Economic research in the North: from the past to the future” at the Institute of Economic Problems. The conference participants were asked to fill in a questionnaire devoted to strategic issues of the state policy in the North. Thirty-four participants filled in the questionnaire, among them nine doctors of sciences, eighteen PhDs and seven specialists with no academic degree. The most representative part of the respondents were from research organizations (17 persons), ten respondents were specialists working at higher education institutions, four – in the bodies of regional and municipal authorities and three – at manufacturing enterprises.

A large group of questions touched upon the prospects of development of the Arctic shelf and the Northern Sea Route, which is quite important for making scenario forecasts. In general, the possibilities of gas production at offshore fields in the Arctic are assessed quite positively: more than 70% of the respondents believe that by 2025 the offshore production of natural gas will reach 100 to 200 billion m^3. With regard to the Shtokman project *(tab. 1)* the majority responded that its “first” gas would be produced in 2020 or beyond (60%).

The development of unique gas condensate fields in the Kara Sea is likely to begin in 2025 or beyond (68% of the respondents); 32% of the participants pointed out earlier periods. As for the necessity to build an LNG plant in the Kola Peninsula, this proposal was supported by only 20 experts (59%); however, there were only two negative answers. The rest did not make up their mind. There are individual differences among the positive answers concerning the period of commissioning and possible output, as shown in *table 2.*

At that, 43% of the responses favored the shipment of LNG to the North American market (NAM), and the European market (EM). One respondent answered in favor of the Asia-Pacific market, two experts did not make up their mind. And as for the construction of an LNG plant on the Yamal Peninsula (village of Kharasavey) a lot more doubts were expressed: only 14 respondents

(40%) believe it is possible, and more than 50% of the respondents found it difficult to answer. The respondents consider five million tons to be the most likely capacity in 2020, and for 2025–2030 the answers are so "scattered" that we do not consider it appropriate to provide them here. As for the orientation, 55% of the respondents speak in favor of the exports to the Asia-Pacific region and 40% – to the North American region.

The last question that was raised was connected to the previous question about the possibility (in accordance with the Principles of the state policy of the Russian Federation in the Arctic) of increasing freight traffic along the Northern Sea Route by 2020. Rather, it concerned the most complicated eastern sector of the NSR (from the Vilkitsky Strait to the Bering Strait), where in 2011 the total volume of cargo amounted to 1.0 million tons.

As seen from *table 3*, 60% of the experts consider that the total freight traffic in 2020 will not exceed 3 million tons; 30% believe that they will oscillate in the range from 3 to 10 million tons (which roughly correlates with the possible export of LNG to the Asia-Pacific market). The volume of transit traffic (in the Western and Eastern sectors) is estimated at up to 1 million tons (85% of the respondents). It should be noted that all freight traffic to foreign ports was considered transit.

Thus, the relatively high volatility of all the factors makes it impossible to identify certain statistical correlations, and forces us to consider some extreme expert scenarios. For instance, in a worst-case scenario we proceed from the following main provisions:

- in the next five years cooling will start and ice conditions will worsen to the levels of the 1980s and 1990s;
- world markets do not experience high demand, the demand is growing only slightly, the prices do not promote the large-scale development of the Arctic shelf;
- as a consequence, the project "Yamal LNG" will be completed in the first phase (16.5 million tons); the Novoportovskoye field will be developed according to a minimum option; The Shtokman project will not be implemented (does not produce) in the period up to 2030;
- transit traffic is growing slightly (not more than by 2–3 times compared to 2014); domestic shipment (including cabotage), including the "Northern delivery" (annual provision of Russia's Northern territories with critical goods like foodstuffs and petroleum products), etc., is also growing at a low rate;
- development of the nuclear fleet is limited to the construction of three LK-60Ya-series icebreakers until 2025 and then another two or three such icebreakers in the period up to 2030, which provides the constant presence of four or five icebreakers in the NSR.

According to the optimistic option, climatic and ice conditions will be very favorable, global markets will grow rapidly

Table 1. Possible term for the beginning of development of the Shtokman Natural Gas Field

	Years when the gas will be produced			
	2016–2017	2018–2019	2020	beyond 2020.
Shtokman project	15	26	33	26

Table 2. Evaluation of the timing of construction of an LNG plant on the Kola Peninsula

2020	Capacity, million tons	10	20	25	Over 25
	Distribution, %	70	15	15	-
2025	Capacity, million tons	20	30	35	Over 35
	Distribution, %	35	45	10	10

Table 3. Export assessment of freight traffic in the eastern sector of the Northern Sea Route by 2020

Marine freight traffic, total	Million tons	Under 1	From 1 to 3	From 3 to 10	From 10 to 20	Over 20
	Distribution of responses, %	21	39	30	10	-
Including transit	Million tons	Under 1.0	Under 2.0	From 2 to 4	From 5 to 8	Over 8
	Distribution of responses, %	61	24	15	-	-

and the shelf will be also developed rapidly. "Yamal LNG" will reach its design capacity of 30 million tons already in 2025; a plant in Teriberka (Shtokman project) will produce the first LNG in 2026, and in 2030 it will reach the level of 30 million tons. The icebreaker fleet and the entire structure of the NSR will be also developing.

It is obvious that between these two options there are quite a lot of opportunities for the development of determining factors and, consequently, the forecast indicators of the dynamics of the NSR. We do not believe it is necessary, given the stochastic nature of dependencies, to carry out some "average" calculations and get the "realistic" scenario – although it can really be obtained by "averaging". However, specific changes can have unexpected results, so it is more practical to introduce changes from time to time in the options obtained.

The significance of this study consists in an attempt to substantiate the impact of individual macroeconomic processes, in particular, the situation in the global markets, on the development of the Arctic marine communications. From the methodological point of view a certain novelty can be found in the connection of the factorial approaches and expert assessments that provide a balanced combination of the analytical and the predictive parts. As for practical applications, these include the construction of scenarios and substantiation of measures for the development of the Northern Sea Route.

In conclusion, we note that the provision of positive dynamics of cargo traffic along the Northern Sea Route and the protection of national interests in the Arctic should be supported by a whole set of measures, which includes:

1. Assessment of climate change and the formation of a system of cartographic materials for different variants of ice conditions in the Arctic in the long term.
2. Development of a comprehensive scenario forecast of freight traffic along the Northern Sea Route for the period up to 2030, depending on the changes in the world's major energy markets.
3. Establishment of favored treatment for international shipments, including with the use of special economic zones in ports; formation of the transit marine corridor "Europe – Asia".

4. Adoption of the Federal Target Program “Development of transport system in the water area of the Northern Sea Route”, which should include the following spheres:

• restoration of meteorological and hydrological support (control) along the entire NSR;

• restoration of the infrastructure of Arctic communications, primarily, existing ports (Khatanga, Dikson, Tiksi, Pevek, etc.) and newly established (Indiga, Sabetta, Kharasovey, etc.), in accordance with the prospective growth of freight traffic, including transit;

• maintenance of the icebreaker fleet (including the construction of new vessels) at the level necessary to ensure transportation in changing ice conditions;

• establishment of conditions along the Northern Sea Route, which are attractive for carriers (tariff regulation, insurance, safety system, etc.).

5. Normative legal provision of the “economics” of sea communications, including the adoption of the system-wide full-fledge law “On ensuring national priorities in the water area of the Northern Sea Route”.

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Information about the author

Vladimir Stepanovich Selin – Doctor of Economics, Professor, Chief Research Associate, Department Head, Federal State-Financed Scientific Institution G.P. Luzin Institute of Economic Problems of Kola Scientific Centre of RAS (24A, Fersman Street, Apatity, 184209, Russian Federation, silin@iep.kolasc.net.ru)