Contributions to Management Science

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Arctic Maritime Logistics

The Potentials and Challenges of the Northern Sea Route

Springer

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Preface

The modern shipping industry has reached maturity and currently market demand and landscape shifts force industry agents to find new pathways to successful development. Furthermore, the progress achieved with the extended Northern Sea Route (NSR), offering a new competitive transport corridor between Europe and Russia, has made it possible to construct logistics systems and the associated transport infrastructure. These circumstances make commercial exploitation of the NSR the subject of intense focus in many countries actively involved in sea transportation.

The Northern Sea Route (NSR) brings both opportunities and challenges to global logistics systems. Severe climatic conditions and the lack of necessary infrastructure makes the Arctic region rather complicated and expensive for such a global business initiative. On the other hand, the NSR project becomes more feasible as global warming progresses, and an increasingly wider range of services are provided by modern IT and digital technologies.

The exploration of the Arctic has seen a keen interest from government bodies, scientific communities, and businesses. Special approaches need to be taken to the development of the region due to the following characteristics: extreme climatic conditions; pivotal importance of developing the territories; low population density, insufficient labor force; remoteness from major industrial centers, inaccessibility of regional facilities; high resource intensity, dependence on the supply of resources from other regions; low sustainability of ecosystems. The Arctic is the region with the highest undiscovered hydrocarbon potential in the world. The development of hydrocarbon deposits in the Arctic requires, among other aspects, a sufficient transport and logistics infrastructure for oil and gas transportation from the offshore zone to the next point of the supply chain. The transport and logistics infrastructure of the shelf zone and the region as a whole is one of the key factors for the economic, social, and environmental efficiency of shelf field development. Container shipping along the NSR is supposed to play a major role in the transportation of oil and gas from the Arctic offshore zone.

The same as container shipping has recently revolutionized commercial maritime logistics, digital technologies now serve the same purpose, enabling the shift toward a new paradigm in the industry. The NSR ecosystem requires new (digital) business models to be developed for all the participants and stakeholders of this project. The key players of the logistics market are seaports, shipping lines and other carriers, state authorities, shipbuilders, and IT providers. Nowadays, seaports are supposed to provide the appropriate infrastructure and digital platform for efficient maritime logistics operations. Carriers need to be integrated into the shared data space of the ecosystem. Specially designed ships of the Arctic commercial fleet are intended to incorporate the digital architecture, serving as self-contained elements of the information exchange within the logistics operations process. Stringent requirements for the new digital architectural concepts allow the participants of the Arctic maritime ecosystem to gain competitive advantage, providing strategic alignment of business and IT architecture for further successful development in the region.

Thus, the transformation of all the above-mentioned elements toward integration into the maritime logistics system evolving in the Arctic is essential for the success of the NSR project. Analysis of the existing experience, research, and best practices in the following areas lays the foundations for finding efficient solutions for Arctic maritime logistics system:

- Adopting the Smart Port concept for maritime ports
- Developing digital platforms for supporting communications in the maritime logistics system
- Optimization of port operation
- Decision-making in maritime supply chains
- Digital architectures for shipping lines and other carriers
- Transport and logistics infrastructure management for Arctic projects
- Sustainable development of the Arctic zone
- Logistics solutions for offshore oil and gas exploration

The key research open questions discussed in the book are:

- What are the drivers, incentives, opportunities, and challenges of the NSR project?
- How can the logistics systems of Europe and Asia (seaports, shipping lines and other cargo carriers, oil and gas industry) and the Arctic region benefit from the NSR?
- Which drivers promoting the development of business ecosystems are involved in the NSR project?
- What is the role of digital platforms and data management for the Arctic maritime ecosystem and for the NSR project?
- How can the logistics system of the NSR be integrated with the logistics systems of Europe and Asia?

Solutions to the problems outlined in the book can be found by calling on the accumulated knowledge of researchers and practitioners with competencies from diverse areas, including transport and logistics, Arctic studies, IT and digital

technologies, socio-economic systems analysis, hydrocarbon production, transport and business modeling, design of information systems and applications, and requirements engineering for IT services.

This book represents the integrated experience and expertise of the researchers from Peter the Great St. Petersburg Polytechnic University (Russia), Hamburg University of Technology (TUHH, Germany), University of Twente (Netherlands), Business School of Rotterdam (Netherlands) and others, as well as experts from oil and gas enterprises, shipping lines, logistics companies, and IT companies. It consists of 15 chapters that thoroughly examine the logistics of transportation in the Arctic Region, as well as the immense impact of digitization in the realm of the complexity involved in maritime logistics in the region.

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Contents

Northern Sea Route Development Concept

Stanislav Chuy, Igor Ilin, Carlos Jahn, and Tessaleno Devezas

Abstract The issues of the development of the Northern Sea Route are extremely topical at the present time. Moreover, the active development of digital technologies has accelerated the pace of digitalization of logistics in general and sea freight in particular. In this study, a concept for the development of the NSR is proposed, based on the results of the expedition "Digital ship of the Northern Sea Transit Corridor." Among the proposed steps, much attention is paid to the creation of infrastructure, namely digital platforms, the concept and requirements for a digital ship system, digital modeling of the project, the integration of all these systems with each other using cloud technologies, big data, etc. In addition, the paper considers the advantages of the NSR, the importance of logistics in the Arctic zone, as well as the role of logistics in the development of the country's economy.

1 Introduction

The Northern Sea Route (NSR) is considered one of the most promising projects in Russia in the field of transit cargo transportation. The rapid development of the economy of the Asian region, the development of digital technologies, the transition of world-leading companies to a new type of business models based on ecosystems and platform solutions, as well as the emergence of new environmental requirements

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have become reference points for the formation of a new concept for the development of the NSR.

Traditionally, the role of the Northern Sea Route is seen as an alternative to the transportation of goods from Asia along the Southern Sea Route (SSR) through the Suez Canal. The main advantage of the NSR is often declared that it is much shorter (Liu & Kronbak, 2010).

Indeed, the distance from the main ports of Asia (Shanghai) to the ports of Europe (Hamburg) through the Suez Canal is shorter by 40% and amounts to 13,000 km versus 22,000 km. However, according to the NSR, taking into account the average annual speed of 19 knots, the vessel can pass the route through the Suez Canal in 26 days without entering the ports, while taking into account the navigational ice situation, the average speed per year along the NSR is 13 knots and the time of delivery Europe will average 23 days per year.

Thus, the hypothesis that the Northern Sea Route is shorter and thus the cargo will be delivered to Europe faster is no longer a sufficient competitive advantage that will force the main sea freight carriers to change routes. Also, passage along the NSR routes requires ships to have an Arctic class, which means it becomes more expensive to build and even has significant restrictions on speed and seaworthiness in open water due to the specifics of the hull for passage through ice (Moe, 2020).

Therefore, it can be concluded that the development of the Northern Sea Route as a competitive transport route of the Russian Federation (RF) on the world market, including as a transport corridor of global importance for the transportation of national and international goods, should be based on competitive advantages that are not associated with the traditional perception of the NSR as more short and fast way in relation to the Southern Sea Route (Didenko & Cherenkov, 2018).

Among other things, it is worth noting that in the structure of world logistics, the first place in terms of the volume of transported cargo is taken by sea logistics. Sea freight is not only the cheapest, but also a strategic type of transport, providing an average of 75% of traffic between states. With the production specialization of macroregions in the context of globalization with a sharp increase in the volume of world trade, the role of sea transport in intercontinental foreign trade transportation becomes critical and already reaches 90% of the total freight traffic (Travkina et al., 2019). Therefore, there are sea routes and logistics companies, some of which are state-supported and state-protected with guaranteed reservation of the national cargo base for their carriers. Thus, state protectionism in the field of maritime transport and shipping is a traditional component of ensuring the competitiveness of national merchant fleets: access to the national cargo base, corresponding ports and directions of routes is protected in a legal (and not legal) way. Transnational shipping companies serving maritime transport receive high revenues. At the same time, the cost of freight by sea transportation significantly affects the final price of the products sold and, accordingly, the competitiveness of the transported products, and this stimulates the development of industry in the countries served. The most efficient from the point of view of carriers are container lines transporting products with high added value, minimum volume and minimum weight. The level of

containerization of goods in the world has reached 55%, according to forecasts, this figure in the near future will be 70% (Zhu et al., 2018).

Moreover, the development of Russian and world logistics was influenced by the strengthening of the role of the Asian market (Karanina et al., 2020).

Over the past 20 years, the markets in China and India have grown exponentially. According to the purchasing power parity index, the GDP of these countries grew from $6 trillion to $ 33 trillion and accounts for about 30% of the world economy, with 1/3 of the world's population living in these regions in the amount of more than 3 billion people. Due to economic sanctions, the Russian economy began to drift away from traditional European markets. Also, with the transition of cargo traffic to sea transport, the overland busy Great Tea Route between China, Mongolia, Russia, and Europe ended its existence. Thus, taking into account the peculiarities of the development of the Asian economy and traditionally friendly relations, the markets of India and China opened for Russia (Wang et al., 2020).

It should be noted that the traditional "friendliness" of Russia's relations with the countries of India and China, as well as the countries of the Asian region, is a consequence of the similarity of the models of cross-cultural communication with a focus on long-term orientation and respect for cultural and historical traditions. However, due to the traditional communication system that has developed over the centuries, the transport and logistics system of Russia is focused on trade relations and integration with the economies of European countries. To enter new Asian markets, Russia currently has the Trans-Siberian Railway as its main logistics system.

The Trans-Siberian Railway allows to reduce the time of delivery of Eurasian goods from the sender to the recipient up to 7 days. However, its potential capacity is about 100 million tons and does not exceed 5% of the total Eurasian cargo traffic, and taking into account technological and organizational constraints, no more than 1%. At the same time, in reality, all overland inland Euro-Asian networks serve no more than 1–2% of the total volume of Euro-Asian cargo.

It should also be noted that geographically, not all regions of the Russian Federation have access to this highway. As a result, products manufactured in these regions do not have access channels to the markets of India and China. Also, the most important limiting factor is the rather high cost of delivery of goods through the Trans-Siberian Railway—about 3000–5000 $ /TEU (container).

The main Eurasian cargo traffic follows the Southern Sea Route (Pacific Ocean–-Indian–Atlantic). The extreme points of this route are Northeast Asia—Northern Europe (Baltic). However, Russia, which has a significant potential for occupying a decent position in the maritime transport market in the World Ocean, in particular on the Southern Sea Route, has not yet been represented there as a strong player.

Moreover, 95% of all Russian foreign economic cargoes over 800 million tons/year are served by foreign ships, earning about RUB 1.6–2.4 trillion on the freight of Russian cargo, according to expert estimates. Including on sea container transportation 400 billion rubles. For comparison, the volume (in monetary terms) of domestic civil shipbuilding until 2017 was about 40 billion rubles, and in 2019 alone, due to the construction of nuclear icebreakers, it reached the level of more than 120 billion

rubles. At the same time, this industry continues to experience an acute shortage of orders.

Russia found itself in a situation of extreme vulnerability and heavy dependence on the freight carriers of transnational companies. Monopolization of the transportation of Russian foreign trade goods by foreign structures or their subsidiaries tends to 100%. Since 2018, these companies have begun to refuse the transportation of export cargo to Russian sanctioned companies, as well as to prevent exports or block existing logistics channels for military-industrial complex products (civil and dual-use).

The only direct exit of the Russian Federation to the World Ocean is the Northern Sea Route through the seas of the Arctic Ocean.

Currently, the NSR provides not only new opportunities but also a new look at the industry in general and maritime logistics in particular.

This work will consider the following aspects of the formation of the concept for the development of the Northern Sea Route on the basis of the expedition "Digital ship of Northern Maritime Transit Corridor" on board the nuclear-powered ice-breaker-transport lighter-carrying container ship "Sevmorput:"

- New role of logistics and digital technologies in the development of the economy.
- The importance of sea freight for the economies of Asia and Europe.
- Features of Russian logistics in the international economy of the twenty-first century.
- New competitive advantages of the NSR.
- Digital trading platforms technology for entering Asian markets.
- Marine logistics in the Arctic Zone.
- Creation of infrastructure for the implementation of Northern Maritime Logistics.
- Digitalization: digital platforms, digital ship, digital modeling, and cyber security.

2 Methods

To search for solutions to realize the transport potential of the NSR during 2019–2020, a working group, "Digital Ship of Northern Maritime Logistics" was formed from more than 150 experts and representatives from more than 50 enterprises from various industries, scientific, and design organizations, leaders in the design of Arctic class ships, design, and manufacture of equipment for marine energy, nuclear, hydrogen, and other alternative types of energy, new structural materials, marine instrumentation, radio electronics, telecommunications, navigation, and communications.

The main tasks of the expedition project were:

- Modeling of the cargo base of the Northern Sea Transit Corridor
- Creation of the main fleet of the Northern Sea Transit Corridor
- Creation of digital services for the Northern Sea Transit Corridor system

- Providing external info-telecom infrastructure of the Northern Sea Transit Corridor
- Technologies for digitalization of logistics

Twenty working and strategic sessions were held, at which more than 50 reports, reviews and reports were heard, hypotheses were formed about the development of international and regional cargo transportation on the Northern Sea Route, where the future of shipping lies in the creation of intelligent marine transport ecosystems based on digital smart ships built on digital technologies modeling, digital twins, cybernetic platform services based on technologies of satellite complexes for remote sensing of the earth and the provision of high-speed Internet (Koronatov et al., 2020).

To test the formed hypotheses, an expedition was organized with scientific support and with the participation of leaders of scientific schools on digital modeling SPbPU, MIPT Phystech-Tsifra, Moscow State University named after M. V. Lomonosov, Faculty of Economics, which took place on board the world's only nuclear icebreaker-transport lighter-carrier container ship "Sevmorput" in September 2020.

For 18 days from September 8 to September 25, the expedition members covered 6800 nautical miles along the route from Petropavlovsk-Kamchatsky to St. Petersburg, having visited ten seas and three oceans.

The expedition made it possible to verify the key hypotheses of the formation of a "reverse" cargo base through the development of the non-energy sector of the regional economy through the development of the Northern Sea Route as a competitive national transport communication of the Russian Federation on the world market using digital platform technologies:

- Conditions for the development of the non-primary sector of the regional economy.
- Requirements for digital platform logistics services in the Arctic Zone (AZ).
- Modeling of our own cargo container base for the NSR.
- Creation of a domestic Arctic cargo container fleet.
- Requirements for the creation of an external info-telecom infrastructure.
- Creation of an intelligent maritime transport system in the RF AZ.

The results of the expedition are clearly shown in Fig. 1.

3 Results

Currently, digitalization has a significant impact on all sectors of the economy, and logistics is no exception. The development of digital technologies in water transport has significantly changed maritime logistics (Egorov et al., 2020). The future of shipping is now promoting the creation of intelligent marine transport ecosystems

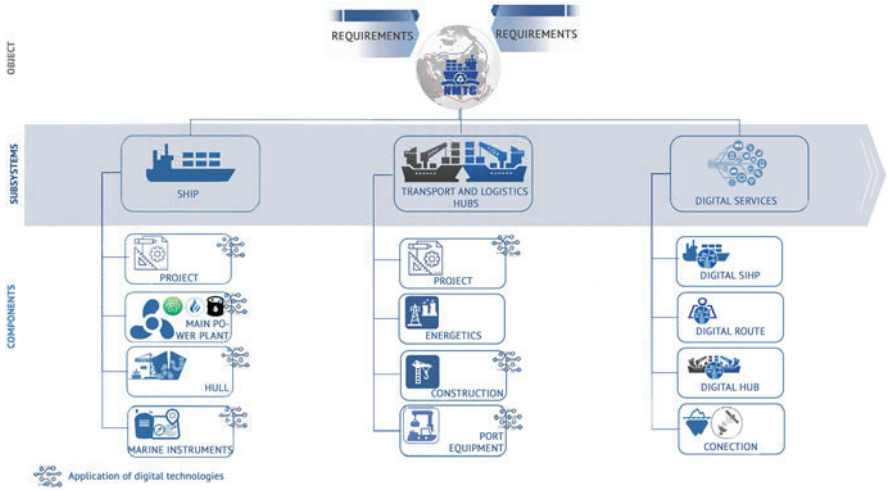

Fig. 1 Navigator of the expedition results in the architecture of the tasks of creating the logistics system of the Northern Sea Transit Corridor (authors' creation)

based on digital platform services built on digital modeling technologies, digital twins.

3.1 Application of Platform Business Models

The emergence of digital eco-platform technologies has made it possible to reduce transaction costs and multiply accelerate the interaction of participants in trade processes related to meeting supply and demand and delivering goods directly to a specific customer. Competitors gain market share not by devices but by entire ecosystems. Platforms benefit because they create new markets and open up new sources of value (Ilin et al. 2020a).

In the twentieth century, supply chain management (logistics) was the main aggregator of business value. In the twenty-first century, the emergence of digital platforms that make it possible to significantly reduce transaction costs and multiply the speed of interaction between participants in trade has become the main dominant in the development of world leaders. So eight out of ten top most expensive companies in the world in 2020, Microsoft, Apple, Amazon, Alphabet (Google), Facebook, Alibaba, Tencent, Visa, do not own production assets in the traditional sense but use a business model based on digital platform services.

The platform business model allows companies to expand at an unprecedented rate. This is the essence of the mechanism of work. Now competitive leadership has become not only the ability to model markets, own standards but also manage distribution channels based on platform business models.

Digital platforms in the implementation of a multimodal method of delivering products using various types of transport, sea, railway, air, auto, have become the determining factor in the competition in the logistics services market.

Thus, logistics based on digital platform business models has become one of the dominant factors (tools) for the development of global business and production.

Traditionally, entering new markets requires a long time, establishing contacts, conducting trade negotiations, business meetings, travel. However, over the past 5 years, due to the development of digital trading platform technologies, entering the markets, searching for goods, counterparties, and concluding a trade deal, purchasing goods can take a fraction of a second, while transaction costs associated with ensuring trade tend to a minimum, many processes are depersonalized and unified, which improves both safety and quality of services.

That is, one of the important tools for the development of the regional economy of the constituent entities of the Russian Federation is the availability and technologies of access to such trading platforms such as Amazon, Alphabet (Google), Alibaba, or the creation of its own domestic platform for the RF-Asia trading ecosystem. Declare about your product and the future buyer will find and buy it.

The presence of social services contributes to the promotion and search for goods, as well as building sales strategies and concluding deals. Networks like Facebook, national vk.com, the formation of their own Big Data databases, their storage, structuring, processing (Ilin et al. 2020c). With such specialized trading platforms, regional products, as well as products from the Asian region, will quickly form their markets.

3.2 Organization of Arctic Maritime Logistics

An important and key element in trade relations is the fact of receipt of the goods, i.e., its delivery. As mentioned above, it was the lack of effective transport routes that was a constraining factor in the development of interaction between the economies of the regions of the Russian Federation with India and China. The only transport highway that works regularly and connects the Russian Federation with the markets of the Asian region is the Trans-Siberian railway, which has significant capacity restrictions (100 million tons of cargo per year).

However, not all regions, especially in the Arctic zone of the Russian Federation, have comfortable access to this artery. At the same time, the cost of shipping a container to China will be about $ 3000–4000/TEU. On average, in the world economy, the cost of delivery of products is up to 10% in the cost structure, in the Russian Federation, transport costs are two times more, up to 20% of the cost of products, which makes the products uncompetitive.

In search of effective transport communication to interact with the markets of India and China, the Northern Sea Route is acquiring new significance.

The NSR should be considered not only as a tool for the implementation of cargo traffic between Asia and Europe but on the contrary, as an independent transport

route with its own national cargo base (based on the regional economy of the constituent entities of the Russian Federation) for the delivery of non-resource export products to Asian markets, as well as the delivery of demanded products to regions.

The absence of a national regional cargo base was indicated as one of the main problems in the development of the NSR as a national system of transport communication.

At the same time, the use of digital modeling technologies made it possible to see that the provision of a regular schedule for the movement of transport vessels along the NSR will allow planning the delivery of goods to Asian markets. And the use of digital trading platforms will significantly revive the possibilities of meeting supply and demand and will give a powerful impetus to the development of production in the regions (Li et al., 2021).

A model pilot analysis of the formation of a cargo base in the Komi Republic showed that it is precisely the lack of regular logistics that is the key limiting factor for the growth of the export potential of the region's industry in terms of food products, building materials, mining, and timber industry products.

The results of the pilot modeling showed that the development of the Northern Sea Route opens a window of opportunity for the industry of the Komi Republic and the Ural region to access Asian markets. The potential of the Komi and Ural industries in forming a cargo base from West to East makes the northern maritime logistics project more cost-effective and sustainable.

Further expert analysis showed that for the regions, the presence of rhythmic northern logistics, which opens up effective access to Asian markets, makes it possible to revive industries traditional for these regions, even without significant investments in modernization at the initial stage.

The peculiarity of the geographical and territorial location of the regional economies of the constituent entities of the Russian Federation along the main Siberian rivers makes it possible to develop river-sea logistics at lower costs through inland waterway shipping and the presence of Russian post offices in almost all settlements makes it available to the delivery of freight items of any volume from parcels to consolidation to international transportation in sea containers.

Thus, the levels of Arctic maritime logistics can be classified into the following functional levels:

1. Trunk (ocean)—for the implementation of international freight traffic, incl. Transit from Asia to Europe. In this direction, the most effective use of vessels of the "Panamax" type. Vessels with a cargo capacity of 10,000 TEU.
2. Aggregate (sea)—for the implementation of federal coastal shipping along the NSR with a call to the ports of the Arctic zone of the Russian Federation Murmansk, Arkhangelsk, Naryan-Mar, Sabetta, Salekhard, Dikson, Tiksi, Pevek, including the ports of Kamchatka, Sakhalin, Vladivostok. Vessels with a cargo capacity of 3000 TEU.

3. Regional (river-sea)—for regional access through the main basins of the northern rivers Dvina, Pechora, Ob, Yenisei, Lena, Kolyma: Feeder vessels with a cargo capacity of 300 TEU.
4. Municipal (river)—to carry out the functions of delivering the so-called last mile to the settlement, pier, village, ships with a cargo capacity of 10 TEU.

3.3 Creation of the Arctic Cargo Fleet

A special place in the development of northern maritime logistics is occupied by the construction of a commercial fleet; the costs in this industry can be about 80% of the cost of creating the entire infrastructure (Sergeev et al., 2021).

Thus, the Arctic cargo container fleet is the main core of the project. The service life of Arctic vessels due to their "high cost" due to operation in ice conditions and the payback policy should be 40 years. Such a service life requires the creation of competitive technical solutions that are ahead of the vision of technology development by half a century (Ilin et al. 2020b).

A lot of resource constraints are imposed on the ship's design, associated with its use in a specific environment of "habitat" in harsh and extreme conditions in the Arctic navigation region. At the same time, the vessel must meet all the requirements for environmental friendliness, and solutions for ship power engineering should give a significant economic advantage in relation to traditional solutions on ships of the southern sea route passing through the Suez Canal (Fadeev et al., 2021).

To create an Arctic cargo fleet, it will be necessary to implement an unprecedented program of construction by 2030 of about 30 large-tonnage container ships (700 billion rubles) of the Arctic class with a displacement of more than 100,000 tons with various cargo capacities of 3000, 5000, 10,000. TEU with a competitive power plant incl. on nuclear power plants, LNG, and possibly hydrogen, with the most modern digital ship systems and complexes.

When preparing for the construction of ships, important aspects should be considered:

- Strategic current capacity utilization of SC Zvezda B. Kamen until 2030 (the only place in the Russian Federation where ships of this class can be built).
- Working out the policy of international cooperation with foreign shipbuilders in terms of preventing the transfer of Russia's unique competencies in the Arctic shipbuilding to them.

3.4 Cybersecurity Digital Solutions Procuring

The role of digital technologies in all spheres of life and production is constantly growing, and at the same time, the risks associated with cyberspace are increasing.

Cyberattacks are among the top five threats to humanity, along with natural disasters and climate change, according to a recent report from the World Economic Forum.

Cybersecurity is the process of protecting and restoring computer networks, devices, and programs from any type of cyberattack. Cyberattacks pose an increasing threat to the preservation of sensitive data as attackers use new methods, such as artificial intelligence to bypass traditional security measures. All industries face the threat of cyberattacks, and such an important area as logistics is no exception.

The use of digital technologies and digital platform services at the stages of creating the northern maritime logistics of the NSR, as well as during its subsequent operation, will make it possible to create a project with excellent characteristics—to form a coherent ecosystem of project participants. It is this "comprehensive" service that will have a competitive edge.

Digital technologies proposed for implementation in the project, based mainly on the analysis of big data, the development of smart algorithms for the created ecosystem of the NSR, will allow increasing the speed of the vessel in a complex meteorological situation due to predictive analytics, build optimal routes, expand the list of services provided by digitizing the vessel and its functioning as an element of a single transport ecosystem, minimize the impact on the environment and strictly control its condition, making transportation environmentally friendly and safe (Jahn et al., 2020).

Also, in connection with the latest world unstable trends and the avalanche-like development of digital services, the security of court management in critical situations, as well as ensuring information security and data security affecting commerce and safe operation, is becoming one of the most important factors in the technical issues of ship construction and equipment their respective equipment (devices, communications, navigation).

This is evidenced by the fact that the IMO (International Maritime Organization) issues different regulatory documents and guidelines for cyber risk management in the maritime industry. An important stage in this development is the transition of a vessel from an independent business unit to modern platform business models based on ecosystems, which requires the integration of ship complexes with the cyber platform of digital services of the Northern Sea Transit Corridor (see Fig. 2).

3.5 Export Potential Development

Implementation of the approach to develop the export potential of the non-energy sector of the regional economies of the constituent entities of the Russian Federation with their entry to Asian markets through the development of logistics of the Northern Sea Route will, among other things, allow to form their own national cargo base, as well as launch a program to revive the national merchant marine fleet and create a competitive export infrastructure in Russia and abroad.

It is the development of the domestic regional cargo base that will give stability and competitive advantage for the transition to the next stage in the development of

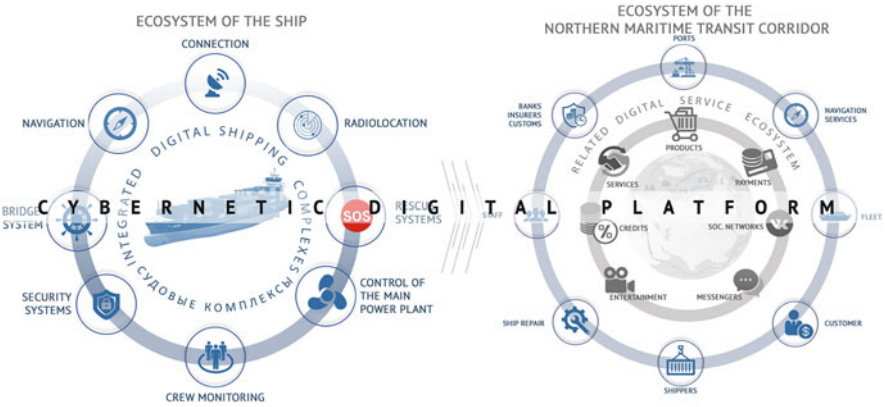

Fig. 2 Transition of a vessel from an independent business unit to platform models (authors' creation)

international maritime logistics and return Russia to the top world leaders in maritime cargo transportation.

About 90% of foreign trade and more than 40% of domestic trade passes through sea routes; in general, about 2 billion tons of cargo are loaded and unloaded annually in the ports of the European Union, more than 400 million people annually use the services of seaports. Marine companies, which are owned by the EU member states, control about 40% of the global flow; The maritime transport sector, which includes shipbuilding, ports, fishing, and related services, employs three million people in the European Union (FSUE Rosmorport, 2013).

When considering this issue, it should be borne in mind that the flow of goods from Europe to Asia is more expensive than from Asia to Europe. It follows from this that the difference in volumetric indicators of oncoming goods flows is even more striking than in value terms.

Foreign shipping companies are already ready to enter beyond the cargo base even into the rivers of Russia, including the Siberian ones across the Arctic Ocean.

Having a reliable cargo or passenger base is the basis for the creation of any transport company. It is this necessary condition that is decisive for the formation of a shipping line company to work on the Asia–Europe–Asia route.

Therefore, the main task for the formation of a domestic shipping container line is the search for a promising commodity base for it in the direction of Europe-Asia, which is solved through the first stage of the development of northern logistics of the NSR through the development of the export potential of the non-energy sector of the regional economies of the constituent entities of the Russian Federation with their entry to the Asian markets through the development of logistics for the Northern Sea Route.

However, the project for the development of SPM through the development of regional economies of the subjects of the Russian Federation has another competitive advantage. The use of river transport within Russia in the formation of the cargo

base leads to the possibility of bringing to the Asian markets not only the regional Russian economy but also the economies of Kazakhstan and Afghanistan. Thus, it becomes possible to loop the logistics route through the SCO countries and make the Northern logistics route of SPM completely independent of the cargo base and European markets.

The second most important task is to provide the Russian shipping company with fuel as a factor in increasing its competitiveness. Therefore, the use of nuclear power on ships is practically the only option in the "fuel war."

3.6 Opportunities and Benefits of Digital Modeling in a Project

The Northern Logistics Project of the NSR—Asia has such significant multiplier effects that the implementation of the Project can help in shaping the elements of the digital transformation agenda for a number of authorities and government agencies of the Russian Federation. The development of the project will affect the GRP (gross regional product) of the regions participating in the project, will contribute to the creation of new high-tech jobs, and will give an impetus to restarting sub-sectors based on end-to-end production technologies in the Russian economy.

The project to develop the export potential of the non-energy sector of the regional economies of the constituent entities of the Russian Federation through the development of logistics of the Northern Sea Route and digital platform technologies is an investment project with high multiplier effects on the GDP and GRP of the regions.

To remove all kinds of risks, to select optimal design solutions for the implementation of such mega projects, there is always a stage of conducting a comprehensive technical and economic analysis.

Currently, in connection with the development of digital modeling technologies, the most advanced form of this analysis may be conducting business modeling, checking the business sustainability of the project with the development of a unified scenario dynamic digital model of competitiveness—a digital testing ground for the Asia-Europe Asia international maritime transport system market,—a virtual testing ground making business decisions (Bui-Duy & Vu-Thi-Minh, 2021).

The Northern Logistics Project NSR—Asia may become one of the first largest projects in Russia, initially created on the basis of the principles of a "virtual testing ground." The creation of a "virtual testing ground for the Northern Sea Logistics Project NSR-Asia" will allow working out the compatibility of digital technologies and business models.

Using digital modeling, it is possible at a strategic level to create metamodels that model markets and an ecosystem of new products, allow assessing the cross-industry and cross-country effects of the created business product, as well as simulate the requirements of future standards to ensure competitiveness in world markets. Then,

an environment of digital polygons should be created, on which architectural, engineering, and cost solutions are tested, and a digital test of the product's competitiveness is carried out. At the digital twin level, we will be able to optimize the product in terms of competitive advantage and carry out dynamic redesign.

The implementation of digital modeling in the implementation and creation of new businesses based on technical complex products is a demanded advanced competence in the world, especially for the implementation of large infrastructure projects, and now it is a "vacant place" in the Russian economy and business.

Key project indicators (expert assessment)

- The timing of the project is harmonized with the activities of the Strategy for the Development of the Arctic until 2035.
- Source of financing: extrabudgetary incl. with the attraction of foreign investment).
- Growth of budget revenues—1–2 trillion. rub.
- Investment growth of more than 3 trillion. rub.
- Development of the GRP of the regions by 4–5 trillion. rub.
- Growth in income, quality of life.
- Providing employment for more than 10–15 million people in depressed regions.
- Infrastructure and spatial development of the RF AZ.
- Development of the non-energy sector of the economy of shipbuilding, mechanical engineering, space industry, communications, electronic instrument making, digital technologies, building materials, food, tourism.

One of the difficult tasks of the development of the NSR as a national sea transport route of international importance is the problem of forming a national regional cargo base.

The use of digital modeling technologies made it possible to see that with a rhythmic schedule of movement of transport vessels along the NSR (cabotage), it allows enterprises of regional economies of the constituent entities of the Russian Federation located along the main Siberian rivers to plan the delivery of goods to Asian markets for products sold using digital trading platforms, which significantly revives the possibilities of satisfaction supply and demand and gives a powerful impetus to the development of production in the regions.

The presence of Russian post offices in almost all settlements makes it possible to send and receive cargo shipments of any volume, from parcels to consolidation to international transport in sea containers.

The use of river transport within Russia in the formation of the cargo base will lead to the possibility of bringing not only the regional Russian economy but also the economies of Kazakhstan, Afghanistan to the markets of India and China, thus looping the logistics route through the SCO countries and making the Northern logistics route of the SPM completely independent of the cargo base and European markets.

It is the development of the domestic regional cargo base that will give stability and competitive advantage for the transition to the next stage in the development of international maritime logistics, access to the markets of Africa, Central, and South

America, Oceania, and return Russia to the top world leaders in maritime cargo transportation.

4 Conclusion and Discussion

The development of the Northern Sea Logistics and the Northern Sea Route is an extremely important area for research and development at the present time. Moreover, this development of this direction is one of the leading tasks in the Russian Federation and corresponds to the goals and objectives set in the Decrees of the President of Russia.

The purpose of this article was to analyze the results of the expedition "Digital vessel of the Northern Sea Transit Corridor" in accordance with the requirements for the development of the Northern Sea Route as a competitive national transport route of the Russian Federation in the world market for the development of services for obtaining competitive advantages in the maritime transport services market, namely the requirements to:

- To reliability
- To the speed and predictable rhythm of cargo transportation
- To information support
- To safety
- To an effective tariff policy
- To integrated logistics services

The Northern Sea Route is a new economic development opportunity. At the same time, the fact that the Northern Sea Route is the shortest route for delivery to Europe is no longer its advantage, and its use does not make it possible to reduce the duration of transportation. It is believed that this project can no longer develop in this paradigm.

The implementation of platform services, that is, digital trading platforms for trade interaction between the markets of the Russian Federation, China, and India, is one of the key conditions for the formation of a base for the development of the NSR. Also, platform services in conjunction with Northern Maritime Logistics ensure the formation of a cargo base based on the existing production and technological capabilities of various enterprises.

Digital modeling technology is able to provide a competitive vessel design for a specific business model by setting key criteria for a commercial fleet. This technology supports the creation of marine transport ecosystems by developing Northern Maritime Logistics.

The development of the logistics of the Northern Sea Route also creates a potential for the development of export infrastructure, thereby contributing to the program of reviving the national marine merchant fleet.

Digital twin and digital modeling technologies enable the sustainable development of Arctic shipping, contributing to the creation of intelligent marine

ecosystems. Also, this direction is influenced by such technologies as remote sensing of the earth and the development of high-speed Internet networks.

Thus, we can conclude that the development of the NSR is a complex task that attracts specialists from different industries to ensure a holistic result that supports such subsystems as ships, ports, and digital subsystems. An important development concept is the seamless integration of these systems, which is possible only thanks to emerging digital technologies, such as cloud solutions, digital twins, big data and others, as well as the creation of digital platform services for the development of the Northern Sea Route as a competitive national transport communication in the world market of the Russian Federation.

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Development of Northern Sea Route and Arctic Maritime Logistics

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Abstract Since the end of the twentieth century, globalization has had a huge impact on the development of all spheres of human activity in the Arctic. In these conditions, as well as considering the climate change, the discovery of new mineral deposits and the estimated assessment of not yet discovered deposits on the continental shelf and international territories, international competition is intensifying for the opportunity to use the Arctic Ocean as a shipping route and to develop Arctic resources. The article analyzes the risks and problems of economic development of the Arctic and possible scenarios for resolving territorial disputes. Obviously, the resolution of controversial issues requires a global consensus, international cooperation, international trade interaction.

1 Arctic Region: Regional Conditions and Challenges

1.1 Arctic and Arctic States

The Arctic is understood as the physical-geographical region of the Earth, bounded along the periphery either by the parallel of 66°33′ north latitude (the Arctic Circle), or bounded by the northern border of the tundra zone. It is sometimes emphasized that the center of the Arctic is the North Geographic Pole. The area of the Arctic, limited by the Arctic Circle, is 21 million km^2, and when limited by the northern border of the tundra zone, the area of the Arctic is approximately 27 million km^2. All this space, called the Arctic, consists of the following spaces: marginal parts of two continents—Eurasia and North America; The Arctic Ocean with all islands excluding the offshore islands of Norway; parts of two oceans—the Atlantic and the

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Fig. 1 Map of the Arctic with the Arctic circle in blue (United States & Central Intelligence Agency, 2019)

Pacific, adjacent to the Arctic Ocean. The length of the coast of the five Arctic countries is 38 700km.of which 22 600km. is the Arctic coast of Russia. http://rareearth.ru/ru/pub/20160804/02368.html, The Rare Earth Magazine, The boundaries in the Arctic will help determine scientists, 4 Aug 2016.

Figure 1 shows a map of the Arctic with the Arctic Circle in blue (United States & Central Intelligence Agency, 2019).

For a long time, the Arctic was considered a territory not adapted for human life ("dead land"), impassable either by water or by land. The Norwegian polar explorer Fridtjof Nansen called the Arctic "the land of icy horror." The first Russian sailors to sail the seas of the Arctic Ocean in the eleventh century. The eastern part of the Northern Sea Route was explored by Russian pioneers Ivan Rebrov, Ilya Perfiliev, Mikhail Stadukhin in the 1930–1940s. Semyon Dezhnev sailed from the mouth of the Kolyma River to the eastern part of the mainland and in 1648 opened the strait between Asia and America. Vsemirnaya istoriya, volume IV-M. 1958, p. 100. Vega Expedition (1878–1880) on the steamer "Vega" for the first time in the world carried out a through voyage (with wintering on the way) by Northeast passage from the Atlantic Ocean to the Pacific and through the Suez Canal returned to Sweden (1880), thus bypassing Eurasia.

Currently, the territory and boundaries of the Arctic have not been determined at the legislative level. Initially, the sectoral approach prevailed, according to which the Arctic was divided between neighboring circumpolar states, with the North Pole being the border of all interested states. The sectoral approach determined the legal status of the islands and lands but did not define the water areas of these sectors. In 1982, the Convention on the Law of the Sea was adopted, according to which the water area of the state extends only to the Arctic shelf, and the offshore zone is international. According to the 1982 Convention, the territorial waters are 12 miles, and the economic territory of the country is a 200-mile zone near the coast.

Countries, territories, continental shelves and exclusive economic zones of which are located in the designated physical and geographical region of the Earth are called "Arctic states." As a rule, two different groups of states are called "Arctic states."

The first group includes five states—Canada, Denmark, Norway, Russia, USA, the coast of which is washed by the Arctic Ocean. They have the coast of the Arctic Ocean, the space of some seas of the Arctic Ocean, they own the continental shelf and can dispose of an exclusive economic zone.

The second group consists of eight states—Canada, Denmark, Norway, Russia, USA and plus Finland, Iceland and Sweden. The coast of Finland, Iceland, and Sweden is not washed by the Arctic Ocean, but they have territories located within the physical-geographical region of the Earth called the Arctic.

The first group of five states until 1982 divided the Arctic into sectors, and this division of the Arctic was quite satisfactory not only for Canada, Denmark, Norway, Russia, USA, but for the whole world. Cold, white silence, icy horror attracted only brave and inquisitive researchers. But global changes in the world led to the abolition of sectoral division and the adoption in 1982 of the UN Convention on the Law of the Sea, but not ratified by all countries. In accordance with the UN Convention on the Law of the Sea, the sectoral division of the Arctic was changed to the country's ownership of the continental shelf within 200 nautical miles. A country can claim a continental shelf and more than 200 nautical miles if certain conditions are met, but with the consent of a special UN Commission created in 1992.

In 1996, at the initiative of Canada, the Arctic Council was created. The Arctic Council includes eight subarctic countries Denmark, Iceland, Canada, Norway, Russia, USA, Finland, Sweden. Six Arctic indigenous peoples' organizations have

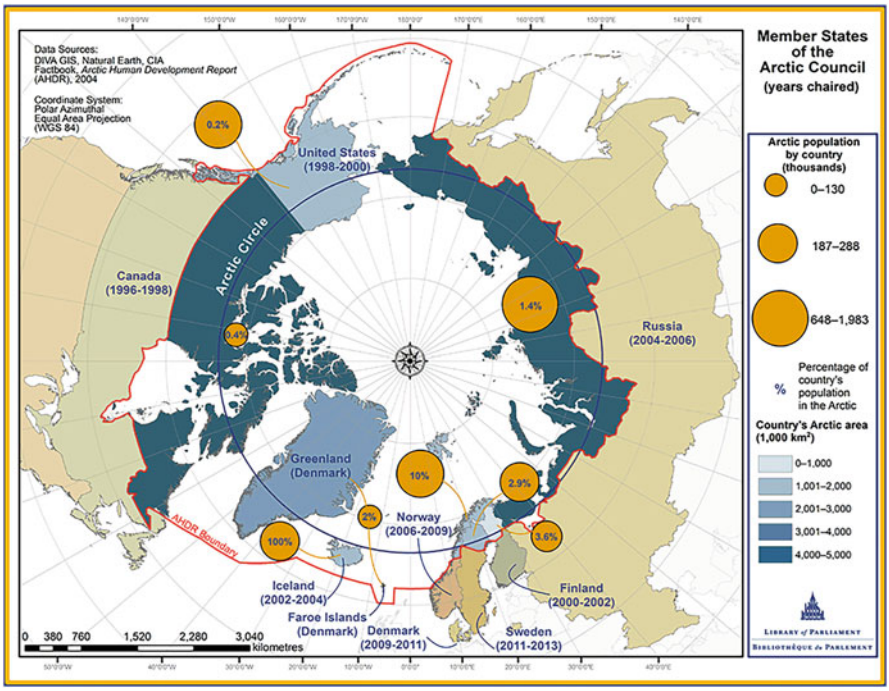

Fig. 2 States of the Arctic council (years chaired from 1996 until 2013) (United States & Central Intelligence Agency, 2019)

special permanent member status. The Arctic Council also includes observer countries, international organizations—observers and non-governmental organizations—observers. Figure 2 shows the member states of the Arctic Council, the population of the Arctic by Arctic countries, the share of the country's population in the Arctic, in percent.

At the end of the twentieth century and the beginning of the twenty-first century, globalization has had a huge impact on the development of all spheres of human activity in the Arctic.

The globalizing world economy is characterized by the openness of national economies, regional integration processes, competition of national economies, competition for geo-economic spaces, population growth in the world, increasing international migration, inequality in the distribution of resources.

In a globalizing economy in the context of climate change in the Arctic, a decrease in the area and thickness of ice, the discovery of natural resources on the continental shelf and international territories, international competition between actors of international activity is intensifying for the opportunity to use the Arctic Ocean as a shipping route and to develop Arctic resources.

The following mineral reserves are located in the bowels of the Arctic: approximately 83 billion barrels of oil; approximately 1550 trillion cubic meters of natural