# Master's degree thesis

**LOG950 Logistics**

**Sustainable development of the Northern Sea Route freight transportation: challenges and perspectives**

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# Abstract

There has been increased attention to developing international freight transportation more sustainably. Maritime transport plays a considerable role as it takes the leading position in global supply chains. Most previous research focuses on economic and environmental aspects (Kontovas & Psaraftis, 2011; Cheng et al., 2013; Dong et al., 2020) but often neglects the social aspect. It remains underexplored how maritime freight transportation can contribute to all three aspects of sustainability. The increase of trading ties between Europe and Asia leads to freight flows between East and West. In this light, a great alternative is the Northern Sea Route (NSR), critical for the social, economic, and cultural growth of remote Arctic regions and international trade in the Arctic transportation system (Hong, 2012). However, there is still a lack of understanding of the NSR feasibility for increasing freight transportation and making it more sustainable in the Arctic harsh conditions (Tsvetkova, 2020).

This master's thesis explores how sustainable development is shaped within the NSR freight transportation by being motivated by the theoretical gap. This purpose was divided into four research questions that focused on historical development, challenges, and perspectives of the NSR freight transportation concerning three aspects of sustainability.

The master's thesis applies a qualitative case-study approach. Our empirical case presents the challenges and nuances of freight transportation along the NSR. Data obtained from a focus-group interview and archival materials were analyzed through a content analysis approach. The investigation presents the historical development of the NSR maritime freight transportation for the last decade. The NSR has been viewed as our contextual settings and the phenomenon itself.

The findings have revealed that the sustainable development of freight transportation along the NSR depends on numerous actors involved that are interrelated and affected by global and domestic regulations. Our findings have also revealed that the economic aspect is the primary driving force behind the development of freight transportation along the NSR, which is beneficial in many ways. Further, our investigation has shown that the environmental improvements reflected in implementing new vessel technologies and providing shorter distances across the NSR are expected to reduce global CO2 pollution. In

addition, the findings have identified that the development of NSR brings many positive and negative impacts on the social aspects.

In particular, it has been emphasized that container shipping can be viewed as one of the most important solutions for the sustainable development of NSR freight transportation. This is due to the fact that container shipping contributes to all three aspects of sustainability – economic, environmental, and social - within the water area of the NSR. Further, our investigation has emphasized the influence of the contextual settings on the development of freight transportation in a sustainable way.

# Acknowledgment

We can now submit our master thesis with great honor and pride after a long and fruitful journey at Molde University College. This journey has been a roller-coaster of emotions and challenges that we couldn't have imagined when we first started studying here. This journey has given us great wisdom and experiences that we know will be valuable assets after leaving Molde University College.

First and foremost, we would like to express our deepest gratitude to our supervisor Antonina Tsvetkova. This thesis would hardly be completed without her amazing support as a supervisor, a counselor, and a friend. Her deep knowledge in the field of research that she shared has dramatically benefited the process of writing this thesis. In addition to that, she had provided us with vital inputs and guidance through many obstacles we encountered on the way. Thank you for your many valuable contributions, suggestions, and constructive criticism, as well as your positivity and a good sense of humor that has helped us get to this critical milestone.

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Last but not least, we would like to thank our family for always being there for us and to our friends for the great memories during these two unforgettable years.

*Lam Gia Bao Nguyen & Dinh Thanh Thuy Le*

*Norway, May 2021*

# List of Tables, Figures, and Abbreviations

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| | |
|---|---|
| ACIA | Arctic Climate Impact Assessment |
| AMSA | Arctic Marine Shipping Assessment |
| CHNL | Centre for High North Logistics |
| GSCM | Green supply chain management |
| IMO | International Maritime Organization |
| INSROP | International Northern Sea Route Programme |
| MARPOL | Prevention of Pollution from Ships |
| MRS | Marine Rescue Service |
| NEP | Northeast Passage |
| NSD | Norwegian Centre for Research Data |
| NSR | Northern Sea Route |
| NSRA | The Northern Sea Route Administration |
| OSP | Oil spill preparedness |
| Polar Code | The International Code for Ships Operating in Polar Waters |
| RQ | Research question |
| SCM | Supply chain management |
| SOLAS | Safety of Life at Sea |
| SSCM | Sustainable supply chain management |
| STCW | Standards of Training, Certification, and Watchkeeping for Seafarers |
| UNCLOS | United Nations Convention on the Law of the Sea |

# Table of Content

# Chapter 1. Introduction

A concise overview of this study is described in this introductory chapter. First, there is the context to the topic selected. After that, we present the research purpose and research questions. Finally, there is a presentation of the structure of this thesis.

## 1.1 Motivation of the study

Globalization of production is inextricably linked to the globalization of trade since one cannot exist without the other. According to Rodrigue et al. (2013), international trade has significantly expanded in scope during the last 600 years, allowing it to play an even more active part in countries' economic lives. Admittedly, the significant commercial dynamism in recent decades is partially clarified by the relatively well-organized distribution networks, facilities, and transport (Krugman, 1991). International trade is a significant driver for the mutual collaboration between national economies and is one of the world's most critical economic practices. With increased spatial interdependencies between global economic elements and their integration level, the extent of globalization is indicated through international trade. Technological advancements in the transportation industry have accelerated this tendency. It has reached the stage where longer distances can be exchanged for a shorter time and various cost scales.

Nowadays, freight transportation is an essential activity, supporting economic activities of increasing world trade globalization. Sea transportation is the dominant player in terms of international freight transportation. Sea transport is the cornerstone of globalized commerce and the supply chain, with more than four-fifths of the world's merchandise trade being shipped by sea by volume (UNCTAD, 2019). This is due to several advantages, including a relatively low price and high throughput, even though sea transportation takes longer and depends significantly on weather conditions.

Recently, the sustainable development of the supply chain of freight transportation has become more and more popular. Sustainability aims at adapting to current needs without affecting future generations' ability to satisfy their needs. The sustainability framework is composed of three aspects: economic, environmental, and social, which are often referred to commonly as profits, the planet, and people. One of the most critical global sustainability players is the international maritime sector (Yuen, Thai, Wong & Wang, 2018). Sustainable

development depends not only on the behavior of different actors, including international shipping companies but also on global regulation and domestic regulation. Most previous research focuses on economic, environmental aspects (Kontovas & Psaraftis, 2011; Cheng, Lai, Venus Lun & Wong, 2013; Dong, Christiansen, Fagerholt & Chandra, 2020) and often neglect the social aspect. It is not clear how marine freight transportation can be seen in all three aspects.

The increase of trading ties between Europe and Asia leads to the growth in freight flows between East and West. The Suez Canal, or the so-called Royal Route, is the primary route between these locations. Since 1975, the Suez Canal has served as the primary commercial route. It is the route with the most extensive container shipping routes between Asia and Europe, in 2019 at 507,406,000 tons ("SCA - Navigation Statistics", 2019). The reduction of the arctic ice covering provides a new maritime opportunity for freight transportation between Northern Asian and North-Western European markets. The North Sea Route (NSR) can be further developed as a potential alternative beyond the Suez Canal.

The Russian legal regulations defined the NSR as a shipping lane from the Novaya Zemlya to the Bering Strait. NSR is a part of the North-East Passage (NEP). Historically the motivation to navigate the NSR has been initially economic. The NSR is critical for the social, economic, cultural growth of remote Arctic regions and international trade in the Arctic transportation system (Hong, 2012). About ten years ago, the Russian regulation on sailing along the NSR was changed to make it more favorable for the users of the NSR. Simultaneously, there is still a lack of understanding of the NSR feasibility for increasing freight transportation and making it more sustainable in the Arctic harsh conditions (Tsvetkova, 2020).

## 1.2 Research Purpose

Overall, the master's thesis aims ***to explore how sustainable development is shaped within the Northern Sea Route freight transportation***. The master thesis implies a qualitative case-study approach. Our empirical case provides insights into the challenges and nuances of freight transportation along the NSR. Arctic seas are characterized by many challenges for the development of freight transportation, such as extreme weather conditions, seasonality of the route, cargo unavailability, etc. Many actors are involved in this process, and there is a conflict of interest between them (Tsvetkova, 2020). So, this fact may restrict the

development of NSR freight transportation and make it more sustainable. To reach the overall purpose, we have decided to divide it into four research questions (RQs) to make the case presentation more understandable.

The establishment of frequent lines on the NSR poses a real opportunity in the immediate future. In the last 20 years, many papers on NSR shipping problems seem to have emerged and had their sole targets and focuses. A variety of studies have explored NSR transport's viability, revealing both benefits and difficulties (Ho, 2010; Hong, 2012; Buixadé Farré et al., 2014). With the increasing transit between Europe and Asia in mind, the development of NSR is quite essential. That poses the first question:

**RQ1*: How has NSR maritime freight transportation developed for the last decade?***

Sea shipping is the cheapest transportation way and can carry a tremendous amount of cargo on a vessel. During more extended periods, the ice melting in the Arctic will create new paths for faster shipping. Transport economists have always been interested in economic and freight transport development (McKinnon, 2007; Tapio, 2005; Moschovou, 2017). Economic activity has a strong positive association with freight growth at the stage of industrial development (Alises, Vassallo & Guzmán, 2014). It also raises the following question:

**RQ2*: How does the development of NSR maritime freight transportation contribute to the economic aspect of sustainability?***

The Arctic is so vulnerable to any changes to environmental impact. NSR reflects a decrease of around one-third of total shipping distances and transport days for the Suez Canal currently in operation, which could effectively result in improvements in global supply chains between Europe and East Asia (Bekkers, Francois & Rojas-Romagosa, 2017). However, sea transport relies strongly on fossil fuels (Wan, el Makhloufi, Chen & Tang, 2018). With rising NSR shipping traffic, the possibility of environmental impacts rises. As a result, the next question arises:

**RQ3*: How does the development of NSR maritime freight transportation affect the environmental aspect of sustainability?***

Indigenous and local people living in very distant regions like the rest of the world, living elsewhere, desire and need the assurance that people live in a healthy environment, where

they may feel safe and secure now and in the future. However, not all social interests are linked directly to the climate and environment. Connectivity needs are steadily increasing in communities that live in Arctic areas. There is not much research or information on the lives of local people living in remote Arctic places, nor how they connect with the world in such remote areas. As a critical maritime transport system, the NSR played a significant role in socio-economic growth (Andreeva, 1998). The development of NSR, which will undoubtedly affect Arctic society, leads to the question:

**RQ4*: How does NSR maritime freight transportation development affect and contribute to the social aspect of sustainability?***

Different kinds of qualitative tools and techniques, including statistics, have been used to find an answer to each of our research questions.

## 1.3 Organization of the thesis

This master thesis is divided into six chapters. The thesis is structured as follows:

- Chapter 1 presents the study's motivation, research purpose, and outline of the master's thesis. The chapter provides an overview of the objectives of the research.
- Chapter 2 contains the literature review that is relevant to the research topic.
- Chapter 3 describes the research methodology and research approach applied in the dissertations and the arguments or justifications for the choices.
- Chapter 4 indicates the empirical findings of the research. The results are the information from the researchers' interviews, which form the foundation of the research's primary data and knowledge from other secondary sources.
- Chapter 5 is the discussion chapter of the thesis that also explains the researchers' findings.
- Chapter 6 is the concluding chapter of the study and comprises the conclusion and implication, including implications for theory, implications for practice, limitations, and suggestions for future research.

# Chapter 2. Literature Review

Chapter 2 presents the review of state-of-the-art studies on topics related to the sustainable development of the NSR. This chapter identifies the main concepts of previous, related literature to this scholarly study, laying the groundwork for this study and the subsequent discussions of knowledge enhancement. This chapter covers literature reviews on supply chain management (SCM), maritime freight transportation, container shipping, sustainability and sustainable supply chain management (SSCM), and three aspects of SSCM: economic, environmental, and social.

## 2.1 Supply chain management

The supply chain is a complex phenomenon and versatile structure, which is not only influenced by technological upheavals but by complex and unpredictable variables such as social and geopolitical problems, like export sanctions, market unpredictability, and the governance of the environment (Mancheri, Sprecher, Bailey, Ge & Tukker, 2019). According to Mentzer et al. (2001, p. 4),

> *"a supply chain is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumer."*

To achieve profitable markets and ultimate maximum benefit throughout the supply chain, SCM is described as a management tool to ensure close ties with consumers and suppliers (Jüttner, Christopher & Baker, 2007). Ivanov et al. (2018, p. 1-3) have been defined SCM as:

> *"cross-department and cross-enterprise integration and coordination of material, information and financial flows to transform and use the supply chain resources in the most rational way along the entire value chain, from raw material suppliers to customers."*

SCM also has been viewed as:

> *"the management of products or services from the design phase, to the different production stages starting with raw material extraction and ending with the delivery of the product/service to the end consumer, and, eventually, the reuse, recycling or disposal phase, depending on the product/service, industries and business models of firms. This includes the management of material, information, and capital flows as well as the management of Human Resources to deliver the product/service to the consumers at a low cost, quickly and at the right place, while still ensuring the quality of the product/service."* (Fritz, 2019, p. 10)

There are many opportunities for study under the SCM umbrella (Mentzer et al., 2001). SCM term significance increased in the 1990s even though it was presented for the first time in the early 80s (Oliver & Webber, 1982). SCM research has grown from an emphasis on economic and environmental issues to the inclusion of social problems (Brandenburg & Rebs, 2015). SCM holds a critical role in every company's growth in the international market (Khan & Qianli, 2017).

SCM is an integral part of many companies and plays a significant role in organization and customer fulfillment. Given that the supply chain involves the commodity from the first production of raw materials to the end customer, an emphasis on the supply chain furthers the implementation and growth of sustainable development (Ashby et al., 2012). Researchers have long concluded that productive SCM is vital for evaluating a company's long-term performance (Christopher, 1992).

Lately, a novel, extensive destructive pandemic named COVID-19 has seriously impacted the global supply chain (Ivanov & Das, 2020). The market disturbances triggered by the recent pandemic of COVID 19 illustrate the necessity of robust supply chains to meet today's integrated world's unstable and complex environmental pressures (Choi, Rogers, & Vakil, 2020).

### 2.1.1 Maritime freight transportation

Shipping can be viewed as one of the oldest vectors of human activity. In the world economy, maritime trade is a primary element. Shipping is a long-standing multinational industry. World freight trade was, and still is, a guiding factor behind globalization. With

growing specialization and globalization, production is further from consumption, and the need for transport is increasingly rising.

Maritime shipping has developed, as maritime transport costs have gradually decreased relative to other transport types. The shipping time of large goods has progressively reduced, and the protection of deliveries has been included, among other factors. Cargo movements of containerized dry bulk commodities will be grown worldwide. The ships' traffic flow is projected to rise with such an expanding demand for waterborne transport. The previous empirical studies indicate that maritime transport has an economic, social, and environmental effect (Kildow & McIlgorm, 2010; Sislian, Jaegler & Cariou, 2016; Niavis, Papatheochari, Kyratsoulis & Coccossis, 2017).

The freight transport sector is an essential element in the nation's economic growth while imposing many negative social and environmental externalities. The involvement of sustainable practices concerns policymakers in transport and involves different supply chain players and expects their corporate associates to reduce their environmental and social effects of the supply chain activities (Oberhofer & Dieplinger, 2014).

It is widely acknowledged that sustainable freight transport networks ensure stable present and future economic growth, transport efficiency, and environmental conservation (Steg & Gifford, 2005). Sustainable freight transport can be provided to integrate environmentally sustainable conservation with profits by reducing costs, generating revenues, maintaining customers, and adding demand, thus improving living standards (Stank & Goldsby, 2000; Abbasi & Nilsson, 2016).

In today's world economy, a global distribution chain with an effective transport system is crucial. The freight transport industry has extensive environmental, economic and social repercussions on the community, and this field should adopt the notion of sustainable development. Each transport mechanism on earth plays a significant role in the sustainability of the world. In the last several years, many studies have stressed the importance of sustainability assessment in freight transport (Buldeo Rai et al., 2017; Kumar & Anbanandam, 2020; Stefaniec et al., 2020). Freight transport positively impacts the transport industry’s sustainability through its effects on the economy, social, and environmental betterment of countries (Norojono & Young, 2003). Sea transport is the most popular mode, as more than 80% of global trade is shipped by sea (UNCTAD, 2019).

### 2.1.2 Container shipping

With globalization accelerating, container transport has become a foreign trading and cultural interchange bridge between various countries. In recent years there has been overwhelming development and success in the container transport industry (C. Y. Lee & Song, 2017)

Container shipping, which started in 1956, makes efficient cargo handling utilizing standardized cargo containers and therefore creates land for freight shipments that have not been bulked, especially for produced products. Since 1995, a new period in the shipping of containers has been recognized, in which the emphasis has again been on technical progress and the related value of caught up in the size of ships (McLellan, 1997). With the advent of shipping containers, shipping has become more and more cost-effective and productive in this mode (Torre, Sarkis & Díaz, 2013).

The performance in containerization is primarily attributed to two reasons. First, the efficiency improvements rendered possible by containerization in cargo handling in ports were part of the rapid growth of containerization (Hayuth, 1992). The second progressive phase included the refining of the leading shipping container networks.

The network has grown from essential East-West roads that bound the three largest economies (Rimmer, 2004), next is North-South routes accompanied by increasing maritime liberalization (Hoffmann, 1998). The growing globalization of supply chains has only enhanced the value of this container shipping in transport. Container shipping is an essential part of the economic growth by delivering consolidated freight facilities on fixed routes among destinations. Study in the area of the value formation of containerized freight transport has been much less carried out.

## 2.2 Sustainability

> *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."* (Brundtland, 1987, p. 37)

Since then, the definition has been continuously improved and refined, and numerous models have been developed to allow the abstract construction to be understood. Sustainable

development illustrates the human community's evolution in harmony with environmental and natural cycles and a responsible economic standpoint. The political aspects are indeed core elements. The limits of economic, social, and environmental resources are often considered in sustainable development to support the present and future generations. They can be implemented, depending on political will at all levels.

"Transforming our world: the 2030 agenda for sustainable development" which is 17 Sustainable Development Goals (SDGs), is a globally agreed global agenda (UN, 2015) aimed at stimulating action towards environmental protection, economic growth, and social equity of sustainability aspects (Fisher & Bonn, 2011), on a long-term. The formation of the SDGs is a remarkable accomplishment in a global human development agreement with some world sustainability goals (Stafford-Smith et al., 2016).

In both science studies and governance strategies, sustainable development is a central theme. Sustainability has gained an increased interest worldwide (Seuring, Sarkis, Müller & Rao, 2008; Reuter et al., 2010; Carter & Liane Easton, 2011). This notion encompasses a balance of social, environmental, and economic aspects (Elkington, 1998; Carter & Rogers, 2008). The three-dimensional sustainability concept seems generally agreed (Dyllick & Hockerts, 2002; Carter & Liane Easton, 2011). Since any participant in society has a position and duty to intervene with global sustainable development, corporate sustainability is a commitment by businesses to global sustainable development challenges (ISO, 2010).

## 2.3 Sustainable supply chain management

Sustainability in SCM, namely SSCM, is a valuable research area. There are more than 16 definitions for SSCM in existence (Dubey et al., 2017). Here are prominent definitions of SSCM:

> *"the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains."* (Carter & Rogers, 2008, p. 383)

> *"the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals*

> *from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements."* (Seuring & Müller, 2008, p. 1703)

Therefore, the SSCM can be deemed a modern level in which the three sustainable development aspects' environmental, social, and economic, are combined. It is essential to mention the Dyllick and Hockerts (2002) acknowledgment that the three dimensions of sustainability – economic, environmental, and social – are similarly crucial to the effective management of a sustainable supply chain (Beske, Land & Seuring, 2014). The SSCM definition has gained traction over recent decades to resolve increasing problems. Still, it is not adequate to concentrate on development and expertise in the supply chain for a business to achieve a great place in the industry (Ansari & Kant, 2017).

Sustainable development of the supply chain needs actions that lead to the most significant economic and social advantage and minimize harm to the ecosystem. Some recent literature reviews (Winter and Knemeyer, 2013) have pointed out that researchers mainly concentrate on some sustainable elements but do not combine all the three aspects of sustainability as a whole. There appears to be a shortage of understanding of how the three aspects function in combination in actual practice.

The SSCM underlines that the flow of information, cooperation, communication, and connectivity through the supply chain network is essential for greater efficiency in the enterprise and supply chains (Rajeev, Pati, Padhi, & Govindan, 2017; Liebetruth, 2017). Few contributions address environmental and social effects, as the economic scope is part of the general supply chain model (Feng, Zhu, & Lai, 2017; Ciccullo et al., 2018).

SSCM has become increasingly important and has become a focus of heightened concern due to natural capital shortages, the world population boom, the corruption of manufacturing development and use practices, and waste and emission rise (Rebs, Brandenburg & Seuring, 2019). By applying SSCM concepts, effectiveness in energy and material and innovation potential will be raised (Gunasekaran & Spalanzani, 2012); produces a very reliable brand reputation in the industry (Zailani, Jeyaraman, Vengadasan & Premkumar, 2012); and improve the operational efficiency of a company (Wang & Sarkis, 2013).

In recent years, scholars and practitioners have been seeking to widen the boundary of sustainable development to SCM to study SSCM (Tseng & Chiu, 2013; Tseng, Tan & Chiu,

2016; Bui et al., 2021). The literature has summarized the evolution of the SSCM in numerous aspects (Rajeev, Pati & Padhi, 2019; Tseng, Wu, Lim & Wong, 2019). For example, Gómez-Luciano, Rondón Domínguez, González-Andrés & Urbano López De Meneses (2018) aims to connect supply markets and globalization using the theoretical basis of SSCM and relevant literature. Meherishi, Narayana, and Ranjani (2019) used a systematic method to better comprehend SCM's sustainable packaging in the circular economy. Rajeev, Pati & Padhi (2019) discussed SSCM patterns through theoretical viewpoints over diverse economic development periods. A systematic, comprehensive, integrated evaluation of SSCM is still missing in the previous studies, rendering it essential to recognize possible openings for new research directions (Ansari & Kant, 2017; Farooque, Zhang, Thürer, Qu & Huisingh, 2019).

Integrating sustainability principles into the significant business sectors, particularly given global environment developments, helps the enterprise gain competitive advantages (Khodakarami, Shabani, Farzipoor Saen & Azadi, 2015). Due to globalization, insecure demand, competitive markets, and financial performance, businesses pose significant challenges to the sustainability of their current supply chain (Roy, Schoenherr & Charan, 2018).

The knowledge of the SSCM has grown; however, guidance is necessary for researchers and potential opportunities (Tsai et al., 2021).

## 2.4 Economic aspect of sustainable supply chain management

In promoting foreign commerce and trade, the maritime sector plays a vital position in the global economic system. As carriers, shipping firms are crucial players in the system. At the time of the worldwide SCM, shipping companies are faced with challenging situations where shippers expect supply chain strategies while searching for lower freight prices. The scale of maritime transport is associated directly with every country's economic development. It guides the country's economy (Lun et al., 2010). Like container shipping, freight rates in many service sectors significantly affect that service's market. Furthermore, the rising size of ships and technical advancements have made marine transport the most economical method of long-distance transport per ton-kilometer of freight transported (Cullinane & Bergqvist, 2014). This has dramatically boosted demand for sea transport services in recent years due to the decline in such services' price.

In SCM's framework, an economically viable sustainable supply chain should particularly enhance profitability (Pagell & Wu, 2009). Lee (2004) described agility, alignment, and adaptability for an effective supply chain's main features. It is a challenge to guarantee transparency, connectivity, communication, and trust in a supply chain (Y. Wang et al., 2015). This will dramatically affect the supply chain's flexibility, sustainability and durability, and other core features. Kurien & Qureshi (2011) have reviewed several performance measures popularly used in supply chain systems to build an SCM framework. Those existing structures' strengths and weaknesses have been identified with strategic, tactical, or operational emphasis from both cost and non-cost viewpoints. As information technology proliferates, businesses and organizations move to IoT technology and digital innovation to tackle the supply chain's problems. Adivar, Hüseyinoğlu, and Christopher (2019) suggested a performance measurement framework in which the core five parameters to be reliably measured are flexibility, efficiency, sustainability, effectiveness, and responsiveness. They examined the omnichannel retailer supply chain framework and stressed that comprehensive performance management based on the evidence is critical for SCM's empirical research.

Operational and supply chain agility has become a critical survival factor in competitive marketplaces with highly volatile and disruptive business environments. Supply chain agility is a supply chain capacity to respond quickly to market environment shifts (Swafford et al., 2006). Numerous reports have explored the background of increased agility across the supply chain. Blome, Schoenherr, and Rexhausen (2013) showed that competence on the supply and demand side made the supply chain more agile and organizational performances more effective. Information technology enhances the supply chain's agility and improves business productivity (DeGroote & Marx, 2013). The supply chain's coordination, collaboration, and communication have been empirically seen as a background of increased supply chain agility and a strong connection between organizational and relational efficiency (Gligor & Holcomb, 2012).

## 2.5 Environmental aspect of sustainable supply chain management

SCM can have a considerable impact, both positive and negative, on the environment, including seas. Today, global environmental concerns have been discussed often in recent

years and impede us from the trajectory of sustainable development as a society. For example, those challenges include climate change (Huang et al., 2016), disposal and handling of waste (Calcott & Walls, 2000), pollution of air and water (Greenstone & Hanna, 2014).

There are numerous possibilities in the supply chain to reduce the business's ecological footprint, for example, by replacing chemical products that can cut hazardous waste generation and management or by reducing packaging waste to be processed. Several scholars have presented examples that enable the supply chain to boost companies' environmental sustainability (Green et al., 1998; Azzone & Noci, 1998; Rao, 2002; Rao, 2005).

Today, global warming is fuelled by high greenhouse gas pollution, which has caused many environmental issues, primarily by transportation practices (Dekker et al., 2012). Björklund (2011) states that environmental considerations are still taken into account when using transport services. The emphasis on environmental protection now moves from optimizing the local ecosystem to bringing the whole supply chain into account. The latest SSCM literature reviews often agree that environmental problems are at the forefront of the discussions in SSCM (Hassini, Surti & Searcy, 2012; Brandenburg, Govindan, Sarkis & Seuring, 2014).

The environmental aspect of SSCM has been disclosed by a considerable number of articles within the green supply chain management area (GSCM). GSCM can be considered as part of the SSCM. There is no consensus about describing and distinguishing the two definitions, and there is an increasing overlap between them (Fritz, 2019). GSCM was described in various literature by numerous authors in multiple ways (Ahi & Searcy, 2013). The definitions, however, use some similar terms (Sarkis et al., 2011) like sustainable supply network management (Cruz & Matsypura, 2009), sustainable supply chains (Bai & Sarkis, 2010), supply chain environmental management (Sharfman et al., 2009), green logistics (Murphy and Poist, 2000) and environmental logistics (González-Benito & González-Benito, 2006), etc. In research from Parmigiani, Klassen, and Russo (2011), GSCM has been defined as the impact of supply chains on environmental performance. GSCM has increased the degree of competition and efficiency of companies concerning the latest regulations and public perception of environmental sustainability as the modern paradigm (Islam, Tseng, Karia & Lee, 2018). Sarkar and Mohapatra (2006) and Wan, Xu, and Dong (2017) claimed

that sustainable business and productive environmentalism are significant green development goals.

Beyond any strategic market reasons for optimizing the supply chain's efficiency, the supply chain's environmental sustainability could also have a beneficial impact (Hafezalkotob, 2017). Tseng (2009) states that environmental issues have emerged separately and increase discipline in managing supply chains. A significant number of international supply chain stakeholders have noticed the environmental aspect during strategic preparation and execution of business processes (Hervani et al., 2005). Companies became more environmentally conscious and demanded eco-efficiency from their supply chain partners (Lee & Lam, 2012). Many actions and legislation have been framed to address environmental issues such as emissions and physical harm and thereby construct a green supply chain (Beamon, 1999).

## 2.6 Social aspect of sustainable supply chain management

The social challenges that society now faces are a critical concern that prevents us from reaching a better sustainable development path. The challenges, such as war (Ousey & Kubrin, 2018), rights of the person (Giuliani, 2016), penury (Bush, 2010). Social sustainability is

> *"the management of practices, capabilities, stakeholders, and resources to address human potential and welfare both within and outside the communities of the supply chain."* (Nakamba et al., 2017, p. 537).

Social sustainability within the SCM can be linked to the goods and procedures evaluated to classify the socio-economic conditions (i.e., wages, safety, labor rights, etc.) of individuals in the supply chain (Mani, Agarwal, et al., 2016).

The social aspect addresses human rights, working conditions, and local societies' effects (Yawar & Seuring, 2015). SSCM gives regions the ability to strengthen their social and ecological efficiency, productivity, and market objectives (McMurray, Islam, Siwar & Fien, 2014; van Hoof & Thiell, 2015). Bendul, Rosca, and Pivovarova (2017) explored whether SSCM's relation contributes to more significant interrelated environmental problems with global implications and local society's growth.

At the same time, companies often ignore the social aspect in practice. Probably – it is required that companies consider societal issues relevant to the supply chain as a strategy but often neglect it in practice. Social sustainability in the supply chain is of the utmost significance because of the need for greater understanding from stakeholders regarding where the product is manufactured and how and under what circumstances (McCarthy et al., 2010).

Social sustainability has been described from the point of view of Corporate Social Responsibility (CSR) in supply chain literature (Carter & Jennings, 2002; Carter & Jennings, 2004; Ciliberti et al., 2008; Carter & Liane Easton, 2011; Lu et al., 2012). CSR is described in many ways from a narrow view (Friedman, 1970) to a broad perspective (Carroll, 1979). CSR includes other concepts emphasizing the political standpoint (Scherer & Palazzo, 2008), business perspective (Watts, 2000), and strategic viewpoints (Hopkins, 2012). CSR reflects the active strategy of an organization towards the community, and CSR actions are, above all, the company's attempts to partake in socially responsible and foster democracy. Moser and Martin (2012) indicate that as companies perform their operations, they participate in socially conscious practices. Likewise, Budianto & Suyono (2020, p. 242) suppose:

> "*CSR is a genuine effort by business entities to minimise negative impacts and maximize the positive impact of its operations.*"

Researchers have suggested various social aspects evaluate for SSCM (Carter & Jennings, 2002; Corbière-Nicollier et al., 2011; Domingues et al., 2015), quantitative and qualitative (Andersen & Skjoett-Larsen, 2009; Tate et al., 2010; Yusuf et al., 2013). Organizations ought to discuss progressive initiatives in their borders and the whole supply chain to boost collective social position. Different parties involved in enterprises' corporate operations are involved and influence their decision-making processes (Govindan et al., 2013; Huq et al., 2016). To achieve a competitive advantage, companies need to be more socially conscious and evaluate their social impacts and achievements and their supply chain actors (Qorri et al., 2018).

Several researchers have pointed out that there is a shortage in exploring the social aspects within SSCM (Gold, Hahn & Seuring, 2013; Sancha, Gimenez & Sierra, 2015), mainly because those impacts are hard to estimate (Zhao, Zhao, Davidson & Zuo, 2012). Many

researchers have stressed that there is a minimal concern of the social aspect (Mani et al., 2016), which has induced difficulties in evaluating SSCM practice development.

# Chapter 3. Methodology

This chapter starts with a discussion of our philosophical position for the research design of this master thesis, where we discuss the two major philosophical models, i.e., positivism and social interpretivism. Further, we present the choice of our research design. The chapter also talks about the data collection process and multiple sources. Lastly, we analyzed the primary and secondary data collected during this investigation.

## 3.1 Philosophical position

In the research design, the philosophical position is the most critical factor. There are two primary opposite philosophical paradigms as social interpretivism and positivism. Positivism is believed that reality exists independently of humans. It is not mediated by our perceptions and is regulated by immutable laws (Rehman & Alharthi, 2016). In contrast, Interpretivism is a "*response to the over-dominance of positivism*" (Grix, 2018, p. 82). In opposition to positivism, interpretivism is a theoretical concept that emerged to study and clarify human and social reality (Rehman & Alharthi, 2016). Both paradigms principally showed their different views in ontological and epistemological assumptions (Collis & Hussey, 2013). Ontology is defined as the "nature of our beliefs about reality" (Richards, 2003, p. 33). Researchers have made assumptions about reality, how it exists, and what could be known about it. Epistemology is known as "*the branch of philosophy that studies the nature of knowledge and the process by which knowledge is acquired and validated*" (Gall et al., 2002, p. 13). It is pertained to "*the nature and forms of knowledge, how it can be acquired and how communicated to other human beings*" (Cohen, Manion, & Morrison, 2017, p. 7).

Our master's thesis is based on an interpretivism philosophical paradigm where we view the nature of our reality - in our case, container freight transportation and the organization of SCM practices - as socially constructed. It would be great as the NSR is a complex network of different actors involved; this is a socially constructed SCM practice. Consequently, this research introduces the NSR through interpretive lenses that address the socially constructed nature of sustainability and sustainability dimensions.

## 3.2 Research design

We have chosen a qualitative research design for our investigation about NSR freight transportation because this type of research design is most appropriate for conducting in-depth and descriptive research to comprehend the various aspects of the phenomenon (Flanagan, 2013). It means, in our case, understanding issues and solutions for the sustainable development of NSR freight transportation. The qualitative method's goal was to create or achieve comprehension, description, interpretation, and explanation of a specific organization or event (Brinkman, Jacobsen & Kristiansen, 2014). Qualitative methods of research should be selected when questions about a phenomenon seem to be requisite. In a study by Gammelgaard and Flint (2012), the qualitative approaches enabled far more research questions to be asked and helped reveal more about SCM's complexity. The descriptive nature of our research necessitated a qualitative research approach:

> "*that qualitative research was concerned with the universe of meanings, aspirations, motives, values, beliefs, and behaviors, which relates to a more complex space of relationships, processes, and phenomena that could not be reduced to the operationalization of variables*" (Maxwell, 2013, p.222)

Our master's thesis was written from both exploratory and descriptive perspectives. The descriptive design examined or tested unique phenomenon relations (O'Brien, Tuohy, Fahy & Markey, 2019). Our investigation was also exploratory with explaining the phenomenon, which was also used to identify specific actions or insights (Tarallo, Akabane, Shimabukuro, Mello & Amancio, 2019). It began based on a general idea, and the research outcomes are used to find out related issues with the topic of the study. The descriptive way enabled us to examine and analyze how maritime freight transportation is crucial globally and impacting the NSR and SCM's sustainability. Our research design's exploratory way gave us an idea of our phenomenon's perspective that helped us identify special activities along NSR.

## 3.3 Case study approach

In the following two citations from Yin (2003, p.13), the case study approach is defined:

> "*A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident*."
>
> "*The case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points and as one result relies on multiple sources of evidence with data needing to converge in a triangulating fashion, and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis.*"

Based on our study's exploratory and descriptive nature, we selected a qualitative and single case study approach to address the three research questions presented in the introduction. The master thesis implies a case-study approach. Our empirical case provides insights into the challenges and nuances of freight transportation along the NSR. The increased traffic along the NSR can bring both advantages and disadvantages in some aspects. That's why it is so exciting to study how freight transportation is developed sustainably. We chose to research freight transportation within these unique empirical settings because the NSR plays a crucial role in the Arctic framework and has become increasingly important to international trade, economics, and the maritime sector in recent years. It was essential to explore how the existing SCM practices within the waters of the NSR have been changing for the last decades. To find out if there are new insights of these supply chain practices in developing freight transportation in a more sustainable way, including all three aspects – economic, environmental, and social. The case study approach was helpful to capture the contextual settings of the maritime freight transportation impacting the NSR and SCM's sustainability. It helps identify the potential influence of the context on the development of the NSR in a sustainable way.

## 3.4 Data collection

### 3.4.1 Primary data

Data collection was based on multiple data sources, including a focus group interview. An interview with a focus group is a conversation where an interviewer asks a small group from the target people a set of open-ended questions (van Es et al., 1998). The name is indicated

by the fact that the chosen groups are “focused” on a particular subject (Lederman, 1990). We conferred with the researchers in a focus group interview with the Centre for High North Logistics (CHNL) representatives located in Bodo, Norway. The qualification criteria for our participants in the focus group interview had specialized knowledge on the subject, being in the age range, and being interested in talking to the interviewer and other participants, according to Richardson and Rabiee (2001).

The interview was performed on February 16, 2021. Our mutual discussion during the interview lasted approximately two hours. CHNL was founded in 2009 as a business foundation with a manager and board of directors to develop an international information center for companies, research organizations, and government agencies on Arctic transportation and logistics. In 2016, CHNL, with an annual contribution from the Norwegian Ministry of Education and Research, was formed as a university center at the Nord University Business School in Bodo. CHNL promotes sustainable, efficient, innovative, and economically and environmentally sustainable transport and logistics solutions throughout the High North. According to their official website, logistics solutions supported practitioners with information and research on Arctic transportation and the preferred source of information for businesses. CHNL has kept current and pertinent information on logistical operations in the Arctic, organizes conferences, and explores and develops project ideas, which case studies or real demonstrations will display. The purpose was to create a link between the business sector, academia, and the government. It is also at the core of the center's function.

To participate in the focus group interview, we invited three researchers. Three researchers were representatives of the Centre for High North Logistics located in Bodø, Norway (Table 3.1). One more participant was our supervisor, Antonina Tsvetkova. She played a role of a researcher because she has vast experience in exploring the Arctic SCM practices and made a trip onboard a container vessel along the NSR between Murmansk port and Dudinka port in May 2016. Her Ph.D. thesis was devoted to SCM in the Russian Arctic. Thus, the involvement of our supervisor was reasonable.

During the focus group interview, a dialogue between all the participants involved, including both of us, master students. The focus group interview was conducted digitally via Microsoft Teams. To direct the focus group interview, a semi-structured interview guide was developed. A few weeks before the actual interview, a list of questions (see Appendix A)

was sent to facilitate the process through email. The interview focused on developing NSR maritime freight transportation that affects economic and environmental, and social aspects of sustainability. We used records during our interview with the consent of each interviewee. All the answers of the participants were hand-written as well. All this could have helped us to make the interview transcription later.

**Table 3.1: Interview respondents**

| **Respondents** | **Position** |
|---|---|
| **Respondent 1** | Researcher at CHNL, engage in energy projects along NSR and transshipment hubs in the Arctic. |
| **Respondent 2** | Ph.D. Research Fellow at CHNL focuses on the potential of container shipping on NSR and analyzing the European and Asian markets for future transportation in NSR. |
| **Respondent 3** | Researcher at CHNL takes part in the environmental impact on NSR and transshipment hubs in the Arctic. |

### 3.4.2 Secondary data

Secondary data were used for trading journals, companies' annual reports, archival materials from the Center of High North logistics, press releases, and official websites. Various secondary data were collected, mainly from the High North Center website, the Russian legislative norms, official annual reports of industrial organizations involved in shipping in the Arctic, press releases, official websites, and other archival materials. The statistics in this master thesis were crucial because they allowed us to analyze the maritime freight transportation development tendencies along the NSR. The statistics were valuable to see the impact of the current increase in freight transportation on sustainability's economic, environmental, and social aspects. Statistics showed a comparison of the development of NSR maritime freight transportation developed for the last two decades. It was

demonstrating the relation of the NSR problems that this article needs to analyze and solve correctly.

## 3.5 Data analysis

During data collection, we received a lot of many different kinds of texts. We analyzed our data by using the content analysis method. Content analysis was first used in political science, journalism, social psychology, political propaganda analysis, and communications research in the early 1940s (Kassarjian, 1977). Content analysis has been studied as an emerging innovative approach (Orlikowski, 1991) and was mainly significant in cultural studies and mass communication studies. One of the primary advantages of utilizing content research to explore social phenomena was that it was non-invasive in nature instead of stimulating social interactions or collecting sample responses. The content analysis could be both quantitative and qualitative (White & Marsh, 2006). In our master thesis, We applied qualitative content analysis. The content analysis was used to assess the purpose of a large amount of data gathered from various sources. We combined different texts from our multiple sources, such as the focus group interview transcription, official reports, Russian legislation, and archival material. It was based on identifying keywords and relies on the interview transcript obtained during the interview.

## 3.6 Research quality

### 3.6.1 Validity and Reliability

Bryman (2016) defined reliability as a procedure for conducting research that allows them to be repeatable. In other terms, it sought to measure the consistency of the research method. The term replicability was very strongly related. To enable potential studies to replicate our results, we created a case study procedure, which is a critical tool for increasing reliability in a single-case study. (Yin, 2003).

Moreover, the focus group interview was recorded and transcribed, allowing other researchers to review our collected data and bolstering the present analysis's reliability. The questionnaires were open-ended to the interviewees, and they had reasonably free and flexible responses. Despite utilizing the same interview guidelines, the future interview

could not receive the same responses. This could be due to a change in occurrences and increased awareness of the researchers' topic.

Validity is related to the significance of conclusions reached in research (Bryman, 2001). Since exploratory case studies were criticized with a certain level of subjectivity due to personal findings and viewpoints, we attempted to improve the research's validation and enhance its concept and external and internal validity (Yin, 2003). In our study, we mentioned a variety of sources of evidence. The latter assisted us in establishing a connection between both the case study outcomes and the research questions. Furthermore, the consent letter was forwarded to the interviewees for evaluation and confirmation, improving the findings' credibility.

### 3.6.2 Generalization

According to Hollweck (2016), testing for external validity addresses determining if the research's findings are generalizable beyond the scope of the case study. External validity is a measure of how generalizable the observable phenomena and outcomes are. The qualitative research approach allowed us to study specific issues of our phenomenon in certain contextual settings of the Arctic waters. Generalizability of qualitative research findings is usually not an expected attribute because studies are often difficult to replicate. The findings in this master's thesis were generalized through analytic generalization as the most common case study approach. This thesis has a thorough literature review on which the interview guide is based, and findings from this study may be generalized to other analogous instances.

## 3.7 Ethical issues

Research ethics is usually viewed as an evaluation of norms and values about research. The assessment considers both the issue and the method used by the study and the implementation of the research findings. All social science research projects collecting personal data, e.g., interviewees' information and interpretations, must be reported to the Norwegian Centre for Research Data (NSD). In early February, this research project was registered and accepted by NSD, meeting their requirements for ethical research practices.

Besides that, the respondents' confidentiality has been strictly protected in the research process. The objective of the research and their rights as informants were presented to the

participants, who also had the option of withdrawing at any moment. Furthermore, the information provided by the interviewees has been kept strictly confidential.

None of the interviewees showed interest in our request for anonymity. However, they did not object to being identified by name and role in this chapter. Finally, each respondent got a copy of all their comments used in this volume at the end of the thesis writing process. They were offered the opportunity to nuance their statements, reinforce their points, or include more detailed explanations in this manner.

# Chapter 4. Empirical findings

Chapter 4 presents our empirical findings based on the data obtained from our focus-group interview and different archival materials. The sections were divided according to the four research questions and include the following: the definition and meaning of the NSR, the historical development of NSR marine freight transportation, shipping traffic on the NSR, administration, and management of the NSR, climate and ice conditions in the Arctic, maritime infrastructure safety and navigation support for shipping along the NSR, and experience of the industrial and international companies in using the NSR for freight transportation.

## 4.1 Northern Sea Route: definition and meaning

### 4.1.1 Definition

Arctic shipping lanes are the sea routes used by ships to cross the whole Arctic or its portion. The Atlantic and the Pacific Oceans are connected with three main routes: the Northwest Passage, the Northeast Passage (NEP), and the principally unutilized Transpolar Sea Route. Moreover, the NSR and the Arctic Bridge are two other essential routes (Østreng et al., 2013).

The NEP is described as the range of sea routes from northwest Europe around the North Cape (Norway) and along the north coasts of Eurasia and Siberia to the Pacific through the Bering Strait. NEP is a historical term connecting the North Atlantic and North Pacific Oceans for the transit path north of Russia.

The NSR is a part of NEP (Figure 4.1). According to Russian legal regulations, the NSR stretches from Novaya Zemlya in the west to the Bering Strait in the east, including the internal sea waters, the territorial seas, the contiguous zone, and the exclusive economic zone of the Russian Federation ("The Federal Law of July 28, 2012, N 132-FZ ' On Amendments to Certain Legislative Acts of the Russian Federation Concerning State Regulation of Merchant Shipping on the Water Area of the Northern Sea Route," 2012) (Figure 4.2). The NSR area, therefore, does not encompass all Russian Arctic waters. The NSR usually is approximately 2,100 to 2,900 miles and is one of the shortest connections

between North-East Asia and Northern Europe (Wergeland, 1992). By mistake, the NSR has often been called for the NEP when mentioned for an international transit line.

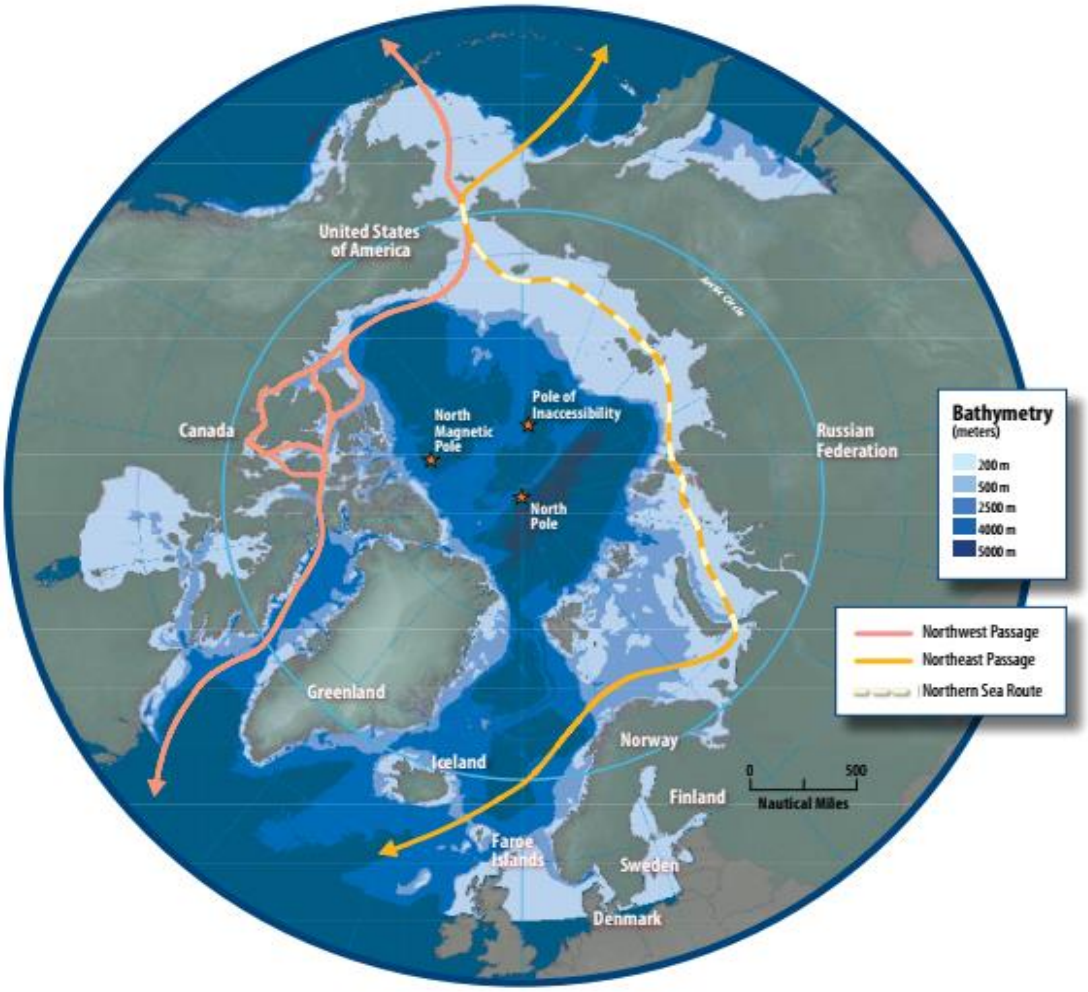


**Figure 4.1: The Arctic marine area**

Source: Arctic Marine Shipping Assessment (AMSA)

In the NSR area, Russia has created administrative and management mechanisms. The Northern Sea Route Administration (NSRA) was established in 2013 in compliance with United Nations Convention on the Law of the Sea (UNCLOS) Article 234 to give the coastal country extensive enforcement privileges in ice-covered areas, ever since the approval of the UNCLOS of 1997 (Solski, 2013; Gavrilov, 2015).

The NSR includes the Kara Sea, the Laptev Sea, the East Siberian Sea, and the Chukchi Sea and is interconnected by 58 straits through three archipelagos, including Novaya Zemlya Severnaya Zemlya, and the New Siberian Islands. The NSR consists of several shipping

lanes that have been used as alternatives (Figure 4.3). The primary determinant of the specific option of routing is the distribution of sea ice. Ice conditions are generally more complex in the route's eastern extremity than the west.


**Figure 4.2: Waters of NSR**

Source: arctic.ru

A certain number of narrow straits impede navigation along the NSR. The Yugorsky Shar Strait, situated along the south coast of Vaygach Island, is the southernmost entry from the Barents to the Kara seas (21 nautical miles long, 13-30 meters deep). The primary transportation line between Barents and Kara's waters is the Kara Gate (18 nautical miles long, minimum depth of 21 meters). The Vilkitskiy Strait divides Severnaya Zemlya from Cape Chelyuskin. This is a significant NSR strait between the seas of Kara and Laptev (60 nautical mile length, 100-200 meter depths), but it is covered with ice all year round, except for a brief period in the summer. Shokalskiy Strait, situated north of Vilkitsky Strait in Severnaya Zemlya, is a second potential shipping path between the Kara and Laptev seas (80 nautical miles long, minimum depth of 37 meters).


**Figure 4.3: Possible shipping lanes within the waters of the NSR**

Source: seatrade-maritime.com

## 4.1.2 Meaning

Nowadays, the NSR has been used in two ways: for domestic usage and for international transit from Europe to Asia or vice versa.

In Russia, the meaning of the NSR in internal transportation is enormous. The NSR is mainly used for Russian supply and export. NSR is the only route for transporting natural resources from remote Arctic areas where there are sparse transportation systems and a lack of infrastructures such as pipelines, roads, and rails. Cargoes, including petroleum, liquefied natural gas (LNG), ores, timber products, construction materials, and also food, medicine, etc., from and for the extremely remote area, have been transported domestically for commodities supplies and export. The NSR has been recast as a significant seaway to export Arctic oil and mineral resources to world markets and as a possible solution to global trading after decades of usage mainly as a Russian national artery for transport serving local communities and the domestic resource industries.

After its opening to international trade vessels, its prospective has increasingly been debated (Solvang et al., 2018) both as an alternate transportation route from Northern Europe to Asia and as a possible rival to the conventional Suez Canal (Liu & Kronbak, 2010; H. Wang et

al., 2018). From Northern Europe to the Far East, the NSR is a shorter distance and travel time than the Suez Canal route, almost 40% nautical miles and days (Figure 4.4). In reality, for specific ports, this advantage can be approximately 45% shorter by distance from the north in Europe to China, Japan, and Korea (Rahman et al., 2014). NSR can be a possible competitor with the Suez Canal. The recent incident on Suez Canal in March 2021 caused global transport networks to be interrupted for nearly a week has proved this. On 23 March 2021, the Ever Given, one of the world's largest container vessels, was stranded and paralyzed on both sides of the Suez Canal. This mishap has shown the importance of an alternative sea route between Europe and Asia for the international maritime industry. The NSR is secure from pirates and possible political unrest along the normal road (Verny & Grigentin, 2009; Katysheva, 2018).

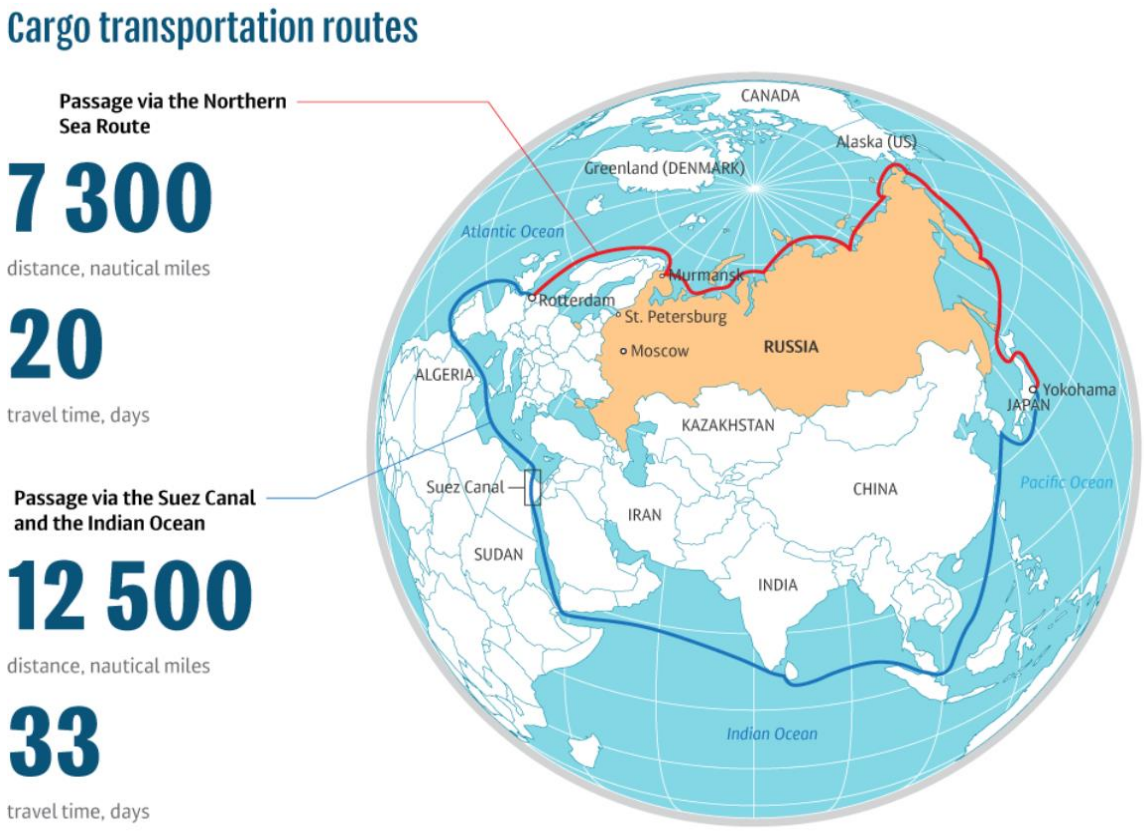


**Figure 4.4: Freight transportation via the NSR vs. via the Suez Canal**

Source: arctic.ru

The NSR has gained interest as a shorter shipping path along the whole Siberian Coast, connecting the Atlantic with the Pacific, owing to sea ice and the growth of the Russian Arctic's natural resources (Buixadé Farré et al., 2014; Moe & Brigham, 2017). Since there

is no one route, all paths between the Atlantic Ocean and the Pacific Ocean through the eastern part of the Arctic Ocean are usually taken into account. The most significant challenge for freight transportation in the Arctic is ice covering for nine months per year. The eastern part of the NSR is more complicated and challenging - especially in the winter navigation due to swallowing waters and many other reasons than the western part of the NSR. The NSR is only accessible primarily in the summer period as international transit, which is a downside of the NSR. However, for domestic purposes – all-year-round in the western part of the NSR.

NSR development is the "backbone" of the Arctic national strategy. For this reason, the NSR is considered a key artery in the Russian Arctic. According to Vasiliev (2021), there are three prominent roles for NSR:

> "- *Become an energy superhighway for export of hydrocarbons and other natural resources of the Russian Arctic;*
>
> - *Supply everything needed to the ports and new "points of economic growth" of the Arctic Zone of the Russian Federation (AZRF);*
>
> - *Assure smooth international transit.*"

## 4.2 Historical development of NSR maritime freight transportation for the last decade

### 4.2.1 Arctic exploration

The European countries extended their influence and pattern of trade into East Asia throughout the 16th century. However, the Portuguese monopolized the regular southbound east-west path, so explorations were organized, primarily by Great Britain and Holland, looking for an alternate and shorter shipping route to markets in India and China at the beginning of the 16th century (Østreng et al., 2013). Economic operations occurred in several areas of the NSR throughout the following decades. The Dutch explorer Willem Barents made many voyages into the Arctic, and the names the Barents Sea and Barentsburg at Spitsbergen were his contributions. But neither he nor his friend navigators in the 17th and 18th centuries reached the Arctic water farther east than Novaya Zemlya's western shores. While Europeans arrived at the gateway of NSR, the indigenous people of Russia

hunted and whaled in the coastal areas of the seas of Kara, Laptev, East Siberia, and Chukchi, everything far beyond the Archipelago of Novaya Zemlya (Pedersen, 2012). Simultaneously, various Russian expeditions across the great rivers of Siberia named Lena, Yenisei, and Ob were expedited into the Arctic Ocean. Contrary to the Arctic motivations of western powers, the Russian expeditions were driven by a need to spread Russia's sovereignty north and east and increase the lucrative fur trade with Arctic natives (Brubaker & Ragner, 2010).

### 4.2.2 Expedition of the NSR

Due to the business operation in its numerous areas, the majority of the coastal parts of the NSR were mapped over the centuries. Thus, it was not until 1879 that the NEP was 'conquered' when after an entire passage from Europe, the Finnish-Swedish explorer Adolf Erik Nordenskiöld reached the Bering Strait, spending one winter on the way. It was a tremendous historical accomplishment throughout his journey. Nordenskiöld, on the other hand, questioned whether this European-Pacific route would be significant in today's world trading trends, believing that the eastern sailing circumstances were too complex for commercial usage. Instead, he was more optimistic about the prospects of creating a reliable traffic route through Europe as well as the Yenisei and Ob estuaries in the Kara Sea, and possibly even to Lena through the Laptev Sea. This information reached the Russian and English governments and contributed to the start of the Kara expeditions. Natural resources, fur products, and agricultural products were exported from the Siberian suburbs on the Ob and Yenisei rivers to the Western European market along the Kara Sea Route, which today forms the westernmost section of the NSR. However, this effort was only moderately effective. In research from Østreng et al. (2013), only 75 of 122 convoys between 1877 and 1919 arrived at their final western terminal, carrying as little as 55 tons of freight.

After the Russian Revolution in 1917, the significance of the NEP as an international waterway was further reduced. The Soviet Union gradually developed the NSR as an internal Russian waterway from this time onwards, especially from the 1930s, to support the industrial development of its Arctic resources. The NSR has been formally operated and managed along Russia’s north and Arctic coast since the middle of the 1930s. A critical integrated part of the Russian Arctic infrastructure, the NSR was used to deliver timber, ores, and other products to the many indigenous, military, industrial, and scientific settlements in the Arctic and the export route. For the first five years, it invested the

equivalent of $1 billion US dollars on exploration and scientific adventures in the Arctic, and it employed almost 40.000 people (Østreng et al., 2013). Though not for international stakeholders, commercial exploitation gradually began in tandem with comprehensive studies (Moe, 2014). Traffic was mainly the destination and in the western part of the waterway in the early years of commercial activity. However, the amount of these vessels increased significantly towards the Second World War (WWII) due to Soviet industrialization of northwest Siberia and increased awareness of the NSR seas due to the scientific works.

It is crucial to emphasize that cargo transportation along the NSR was boosted by developing major industrial complexes in the Russian Arctic, including the mining-chemical, mining-metallurgical, and oil and gas industries (Høifødt et al., 1995; Østreng et al., 1999; Hong, 2012). Then, from the 1930s onwards, the Soviet government emphasized the Arctic and the NSR, investing heavily in infrastructure and allocating significant funds for scientific research (Tsvetkova, 2020). In 1932, the Chief Administration of the NSR was established with wide-ranging authority "to develop a sea route along the sparsely populated coast of Northern Siberia" (Bulatov, 1997). In the summer of 1939, the first industrial cargo ships were launched. However, navigation only took place during summer navigation for an extended period.

### 4.2.3 The vital role of the NSR during WWII and the Cold War

From the beginning of its establishment, the NSR served a critical military position. In 1932, the Soviets were provided the proof by Schmidt's expedition that, if necessary, the two fleets could support each other by using the NSR. This assumption was the correct choice when a convoy of warships crossed the Pacific Sea to Barents in 1942 to assist the Russian arms and supplies lifeline, including Arctic convoys from west to east (Moe, 2014). 1942 was also the year when the most significant number of ships in those convoys fell in German submarines, leading the Allies to experiment transit with the NSR merchant convoys. This tactic was effective, and in summer, 120 ships sailed from the Pacific to the west of the NSR with U.S. fuel, armament, and other provisions, preventing German attacks (Brubaker & Ragner, 2010). These experiences of ship convoys during WWII pointed to the fact that the NSR can transit cargo transportation. This also showed the strategic significance of the NSR.

These prospects were not further pursued commercially after WWII, with just a few exceptions. But, military intrigue to Soviet admirals was the notion of eastern west transit. Officials asserted as early as the 1950s "the Soviet Navy in an emergency situation should, by way of the NSR, be able, undisturbed and in a short time, to transfer warships from one sea border of the great Soviet Union to the other" (R. Douglas Brubaker, Willy Østreng, 1999, p.304-305).

The icebreaker, Lenin, was launched in 1959, the world's first nuclear-powered surface ship. It became an essential milestone in the development of navigation along the NSR (Østreng, 1999). The appearance of the icebreakers drastically changed the tactics of ice navigation and significantly raised the duration of the navigation. Extending the summer-autumn periods of navigation to year-round use of the NSR was achieved after diesel-electric icebreakers and ice-strengthened vessels, mighty atoms for Arctic navigation were implemented. Due to increased demand for establishing a reliable transport scheme of interaction between the Norilsk and Kola industrial complexes, year-round voyages have been frequent throughout the western segment of the NSR: Dudinka-Murmansk since 1978.(Høifødt et al., 1995; Østreng et al., 1999).

In the 1980s, the government corporation “Rosatomflot” was set up to operate the most extensive commercial nuclear fleet globally at the height of 38 ships. These ships were essential to promote the expanded number of destinations in the Arctic, even during the brutal winter months.

### 4.2.4 International attractiveness of the NSR

The NSR served regional developmental purposes and did not draw much attention from international companies until the 1990s. In the summer of 1991, the NSR was officially opened to non-Russian shipping, just months before the dissolution of the Soviet Union (Åtland, 2008). From 1993 to 1999, to investigate the circumstances of expanded marine utilization, Russia launched an international study initiative – the International Northern Sea Route Programme (INSROP) (Brubaker & Ragner, 2010). In Japan, a demonstration trip from Yokohama to Kirkenes, Norway, was undertaken with INSROP by the Norilsk Nickel cargo fleet, Kandalaksha, in August 1995. It was in modern times the first international commercial transport trip to the NSR. Two years later, the NSR officials announced the completion of transit by a Latvian flag tanker in 1997 (Brigham, 1998).

However, the NSR did not draw much attention to the world maritime market in the twentieth century. Since the beginning of the 2000s, Arctic shipping along the NSR began to attract world interest owing to the Arctic ice retreat, the increase in the fuel price, and the economic growth of East Asia. INSROP's critical findings on commercial shipping were the extreme sea ice levels along the whole path in the winter and spring. This made technological and economic impossible for foreign shipping. In the coming years, there were no international transit sailings. Then in 2005, the Arctic Council released the Arctic Climate Impact Assessment (ACIA), which highlighted the unprecedented shifts in the Arctic sea ice cover and thickness caused by climate change ("Arctic climate impact assessment," 2006). It also highlighted differences in Arctic sailing conditions. Commercial shipping on the NSR rose again in 2007 as the minimum sea-ice coverage in the Arctic Ocean was reduced drastically that year by studies in September. These fluctuations in Arctic sea ice also led the Arctic Council to carry out its 2009 Arctic Marine Shipping Assessment (AMSA), which highlighted several maritime scenarios resulting from the loss in sea ice, with an emphasis on improving the security of Arctic marine and protecting the ecosystem (Fretheim et al., 2011). As t arctic ice covering reduction provided a new opportunity for freight transportation, the NSR became internationally recognized. In 2009, two heavy lift carriers owing by the German group Beluga Shipping, Beluga Fraternity, and Beluga Foresight, shipped some heavy power-plant modules manufactured in South Korea to the port of Yamburg in the Ob Bay, marking a new landmark for foreign shipping on the NSR (Beluga Group, 2009). These expeditions offered more advantages and a significant increase in the foreign usage of NSR in the next few years.

### 4.2.5 The NSR development between 2010-2015

Several transit commercial voyages along the NSR with icebreaker support from Asia to Europe were completed in 2009-2010 to draw global partners for international transit usage of the NSR. In September 2010, the Bulker Nordic Barents carried iron ore from Kirkenes (in Norway) to Lianyungang (in China) was the first foreign journey by a non-Russian vessel delivering non-Russian freight. Due to reduced travel time, fuel usage, and CO2/NOx pollution, this journey revealed possible savings for cargo and shipowners instead of the Suez Canal (Zhao, Hu, & Lin, 2016). This historic journey was also used to facilitate multinational NSR shipping alliances.

In 2011, the Russian government modified the structure or tariff regulation for icebreaker operations. Tariff prices for icebreaker support stayed unchanged but were redefined as "maximum" to provide for negotiating between icebreaker operators and ship owners under those limits. According to the Executive Director of the Non-Commercial Partnership on Coordination of NSR Use, the new tariff strategy rendered the NSR more appealing, with unprecedented East-west freight transit estimates of 835,000 tons in the summer and autumn 2011. This regulatory reform signaled that the Russian government's position in cargo shipping enforcement remained coercive, though much more responsive to the participants engaged in the day-to-day practice. The Russian government's initiatives on NSR growth seem inadequate to establish a high-quality regulatory structure, organize the participants' activities, and draw investments.

During the years 2010–2013, Atomflot's nuclear icebreakers assisted in evaluating the technological viability of transporting Arc4 ice-class container vessels on the NSR during the summer-autumn season. In these early years, the Russian authorities supported global NSR's trade use, which President, Vladimir Putin, made clear in 2011:

> "*We are planning to turn it into a key commercial route of global importance. I'd like to emphasize that we see its future as an international transport artery capable of competing with traditional sea routes in cost of services, safety and quality.*" (Shubin & Rogachev, 2017).

The Russian administration was aware of the need to improve the institutional and regulatory system if the country enjoyed expanding foreign competition in Arctic shipping. Several legislative changes were made in the control of cargo vessels in the Russian Arctic regions.

Since January 27, 2013, significant changes to the NSR Federal Law had necessitated the re-establishment of the NSRA and the introduction of new navigation laws in the NSR water area. The NSRA managed to organize navigation in the NSR's water area, ensure protected navigation, and protect the marine ecosystem from contamination. Its essential duties included organizing icebreaking, navigational, hydrographic, and legal protection of navigation, working on the reduction and removal of oil spills on the NSR's slopes, and interacting with emergency responders during research on the management and protection of accidents, including natural and human-made disasters on the NSR. In reality, the NSRA mainly provided essential coordination and record dissemination, specifically issuing

permits for a vessel's passage in the NSR's water region and collecting regular updates from shipmasters through the online framework. Electronically tracked vessel traffic around and inside the NSR's water area. With legislation that came into effect in 2013, new laws and guidelines are permanent (Gavrilov, 2020). To lure international shipowners and cargo owners, Rosatomflot, the State Nuclear Icebreaker Fleet operator, presented transport undertakings with advantageous icebreaker tariff prices (similar to the charges of Suez Canal per ton of freight) and more discounts depending on cargo and ballast volumes. The outcome was many business transit trips on the NSR, 2011–2013. There were 28 international transits in the first four years, 18 with a gross freight of 1,20 million tons.

### 4.2.6 The NSR development between 2015-2019

Russia concentrated on internal shipping and location shipping with NSR project cargo to build its energy and mining ventures between 2015 and 2019. The destination journey increased during that time. In comparison with 2010–2013, international transits grew in size but not in freight capacity. In the NSR domestic shipping, non-Russian shipping firms were interested as well. Despite the 2013 changes to the legislative system of navigation along the NSR, which rendered it more favorable for business firms, and many profitable commercial transit voyages in 2009-2010. In the following years, gross freight volumes remained pretty small. It was projected that 2.8 million tons in 2013, 3.7 million tons in 2014, and 5.15 million tons in 2015. The Yamal LNG project began to contribute to internal Russian traffic by supplying natural gas through the NSR. Though internal traffic increased from 7.5 million tons in 2016 to 10.2 million tons in 2017 (a nearly 40% increase), transit volume fell sharply in 2014 and remained difficult in 2017: 1,3 million tons (71 vessels) in 2013, 0.24 million tons (31 vessels) in 2014; 0.04 million tons (18 vessels) in 2015; 0.21 million tons (19 vessels) in 2016; 0.19 million tons in 2017.

This decrease in transit correlated with a steep drop in bunker fuel prices on the global market in 2014, unfavorable freight rates, harsh ice conditions for many years, a lack of commercial ice-strengthened vessels geopolitical problems caused by US-EU sanctions on Russia. These considerations, along with the confusion, significantly decreased the economic value of the time saved by utilizing the NSR over the Suez Canal, over which about 18,000 vessels pass per year. The Russian government started to consider reorganizing competencies for the NSR's future growth to change the condition. New regulatory efforts aimed at strengthening the efficiency of NSR management and growing the economic

importance of the NSR, particularly the amounts of domestic and foreign freight traffic. This phase began in 2016 with a proposal from the Arctic Commission, headed by Deputy Prime Minister Rogozin, to establish a single logistics operator for the NSR to more effectively use infrastructure, including the icebreaker fleet. The Russian government obtained two competing plans for the reorganization of the NSRA in 2017. One strategy suggested for the NSRA to be upgraded and the Ministry of Transport to charge all activities, including the atomic icebreaker fleet. Another plan proposed that Rosatomflot integrate all NSR competencies, including NSR networks, correspondence, navigation, and science matters, to become a key and unified entity of potential NSR growth policy. The new regulatory reform was intended mainly to increase shipping traffic along the NSR and lure international corporations.

Despite difficult ice conditions, more than 18 million tons of freight were transported through the NSR in 2018, a 68 percent increase from 2017. Thick ice was observed on the Kara Sea and the East Siberian Sea throughout the early summer of 2018. However, transit shipments on the path seem to be few. In August 2018, Danish shipping company Maersk conducted what it described as a one-time trial. It was the first to send a container ship filled with Russian fish and South Korean electronics along Russia's Northern Sea Route. It disagreed that the road was economically feasible at the moment, partially because it is only available for around three months of the year due to ice.

According to High North News, Maersk looked into the possibility of providing a service in collaboration with Rosatomflot's nuclear-powered icebreaker. Despite the voyage's popularity, Maersk claims that the Northern Sea Route is still not viewed as a viable alternative to current east-west routes:

> *"Operations in the Arctic pose completely different demands on ships and their design. The passage is feasible for around three months during the summer, marked by a lack of obstructive ice. That said, ice conditions can vary and are, in general, difficult to predict. Thus, assistance by icebreakers which are around to support safe navigation all year will still be necessary. We also must consider that ice-classed vessels are required to make the passage. Further, there will be more dependency with the Polar Code which would also mean additional investments."*

The NSR is becoming more linked to the international market by energy exports, but new regulations in effect as of 1st February 2018 restricts this industry to Russian-flagged vessels (Moe, 2020). Though foreign-flagged ships on long-term contracts signed before this date (carriers for Yamal LNG and gas condensate) were exempt from this provision, these regulations set the tone for Russia's growing influence over potential shipping the NSR involving its natural resources. Subsequent regulations mandated that most carriers and tankers carrying hydrocarbons out of the NSR region be constructed in Russia. Nonetheless, it seems that international shipping firms may play a minor role in potential destination shipping, which is compounded by proposals to establish a Russian LNG shipping business, although with Chinese involvement. Infrastructure requirements are commonly recognized in Russia, and official recommendations for improving the condition exist, most recently in the Plan for Development of the Northern Sea Route Infrastructure until 2035, which the government adopted on December 21, 2019. However, all of the enhancements are prohibitively expensive. Russia has high expectations for significant Chinese infrastructure spending, but the future remains unclear (Moe & Schram Stokke, 2019).

Potential international users of the NSR also try to influence its development. China is one of the most influential actors. So far, China's involvement has been mostly limited to oil exploration ventures and LNG carriers. On the other hand, China released the first white paper on Arctic strategy in January 2018 (Li, 2019). Interests in the area include: continuing to undertake scientific research and activities, protecting the natural environment and reducing carbon emissions, developing the NSR as a transportation artery, and commercial projects in energy, fisheries, and tourism. The white paper reaffirmed China's long-standing attempts to reposition itself as an "Arctic stakeholder" and "near-Arctic" state. China has very little control over Arctic governance as a non-Arctic power.

On the other hand, China believes that it has a credible claim to form the Arctic agenda by asserting itself as an Arctic stakeholder. Economic ambitions in the NSR and natural resource discovery remain China's primary interests in the field. The majority of its operations are carried out in collaboration with Russia (“China’s strategic Arctic interests,” 2014).

## 4.3 Shipping traffic on the NSR

### 4.3.1 Overview of vessel traffic

The NSR is mainly the only way of shipping resources in the distant Arctic areas. It is expected that the Arctic shipping activities remain a guiding factor for the development of the NSR. NSR shipping volumes soared in 1987 and peaked with 6.6 million tons, then dropped dramatically when the Soviet Union collapsed, about 1.7 million in 1996 (Ragner, 2000).

Figure 4.5. illustrates the volume of cargo transportation via the NSR from 2011 to 2020. Overall, the number of cargo volumes in a million metric tons increased over the year. The highest volume of cargoes can be seen in 2020. Between 2011 and 2014, the cargo volume remained relatively static at approximately 3900 million tons. Over the next four years, the freight volume on the NSR climbed four-fold, from 7.5 million tons in 2016 to 31.5 million tons in 2019.

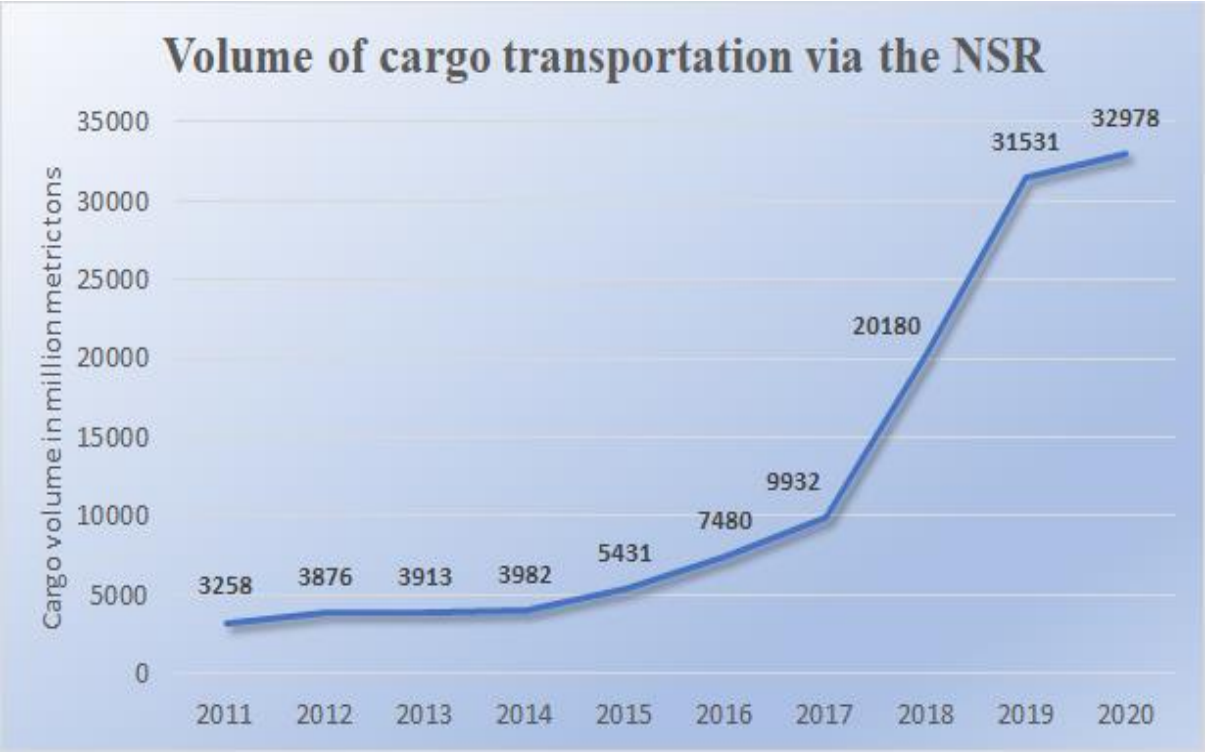


**Figure 4.5: The volume of cargo transportation via the NSR between 2011-2020**

Source: CHNL

The majority of the shipment was for export to the European market. It consisted of liquid hydrocarbons provided by two natural resource ventures in the Ob Bay- LNG and gas condensate from the Yamal LNG plant at Sabetta's port, and crude oil from the Arctic Gate terminal at Cape Kamenny (Novy Port) farther south in the Ob Bay (Gunnarsson, 2021). From 2020, there was a slight increase of about 1.4 million tons (See Figure 4.5.). Development was entirely disrupted when the Covid-19 outbreak threatened the global supply of goods.

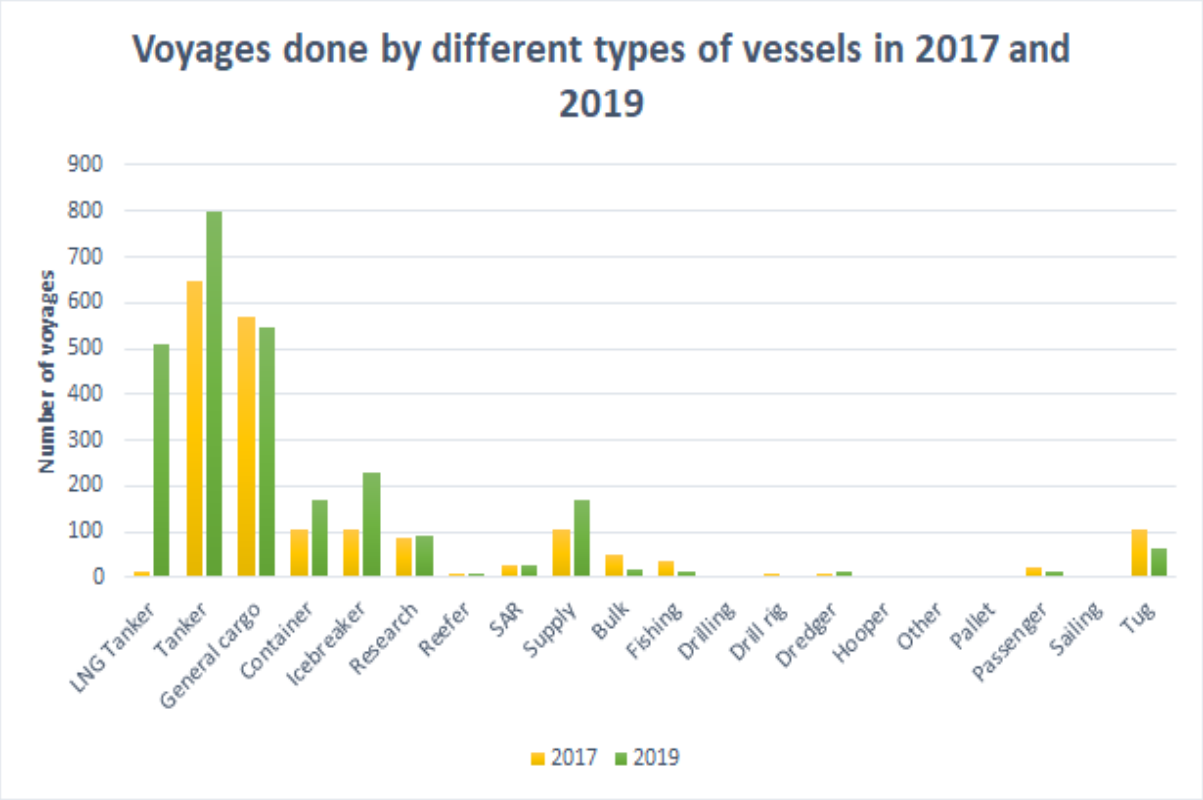


**Figure 4.6: Voyages done by different types of vessels in 2017 and 2019**

Source: CHNL

Figure 4.6 represents the number of voyages done by different types of vessels in 2017 and 2019. In general, the number of voyages in 2019 is higher than in 2017 in the period given. The LNG tanker, tanker, and general cargo types were transported the most in the NSR in 2017 and 2019. Furthermore, the most significant different kinds of vessels in 2017 and 2019 were on the LNG Tanker. 507 voyages were made in 2019, which was approximately fifty-fold in 2017, which was 13 voyages. Regarding general cargo, the number of trips taken

on the NSR was almost similar, with 570 and 576, respectively. About the most type of cargoes, Respondent 1 told :

> *"They are natural resource exportation, especially natural gas. It's driving most of the traffic out of NSR, especially LNG towards the Pacific and to Western European ports."*

Further, Respondent 2 identified the trend of the types of cargo being transported along the NSR recently:

> *"Since Russia has internal petroleum projects like gas projects in the coastline of NSR… Some types of equipment are transported or imported from the European market or Asian market to the areas of the NSR, but it's like temporary traffic. When the construction of Arctic LNG2 is finished, the general cargo traffic will decrease a little bit because right now the types of cargo transport are for the construction of the project."*

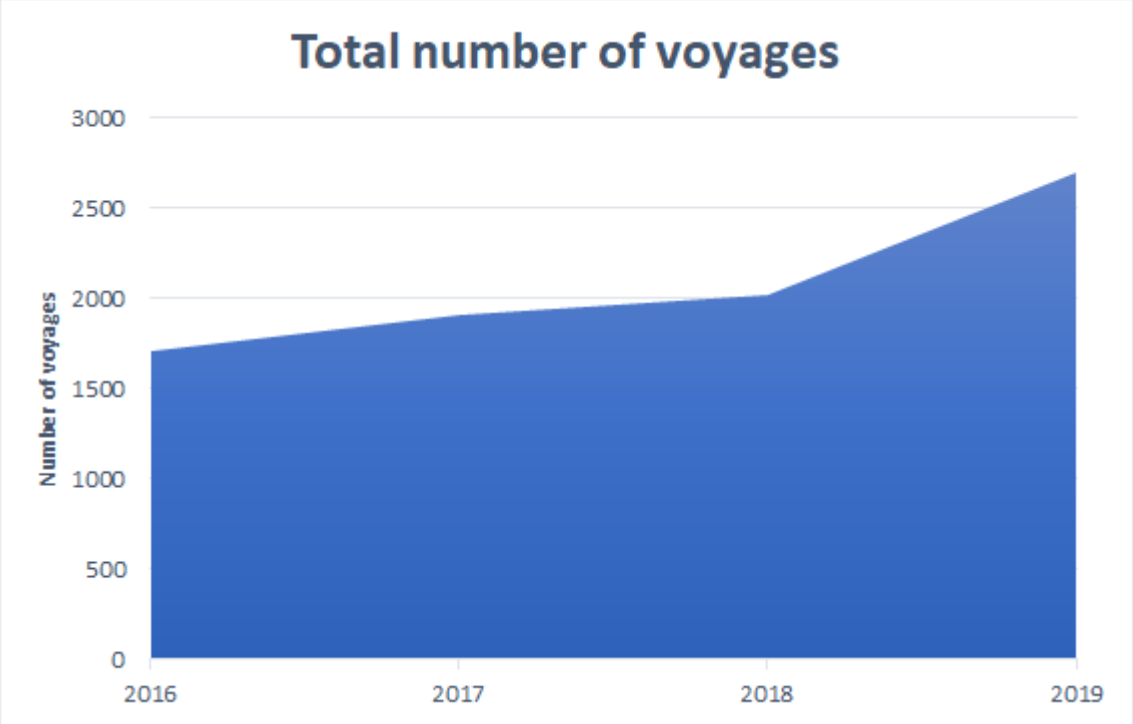


**Figure 4.7: Total number of voyages along the NSR between 2016 and 2019**

Source: CHNL

In the period 2016–2019, the NSR carried out an amount of 8329 different voyages (See Figure 4.7). The number of vessels operating on the NSR per year varied from 227 to 297, and the number of voyages rose by 58 percent, from 1705 to 2694. Over the four years, the growth in voyages was due to improved internal shipping on the NSR, primarily through service/supply vessels and icebreakers. Also, it expanded destination transportation between the South West Kara Sea and European ports by LNG carriers and gas condensate tankers (Gunnarsson, 2021). The majority of voyages occurred between July and October. In the winter-spring period, fewer than 50 vessels were operated on the NSR and inside the South West Kara Sea, Yenisei River, and Ob Bay.

In 2019, 278 vessels were sailing on the NSR, allowing 2694 different voyages (See Figure 4.8). The majority of shipping operations occurred during the summer-autumn period (July-November). The Kara Sea was the only location where year-round shipping was practiced. At the winter-spring time (January-June and December), there was minimal shipping operation in the eastern region of the NSR (the Laptev Sea and the East Siberian Sea). As illustrated in Figure 4.8, the majority of the cargo was LNG and crude oil.

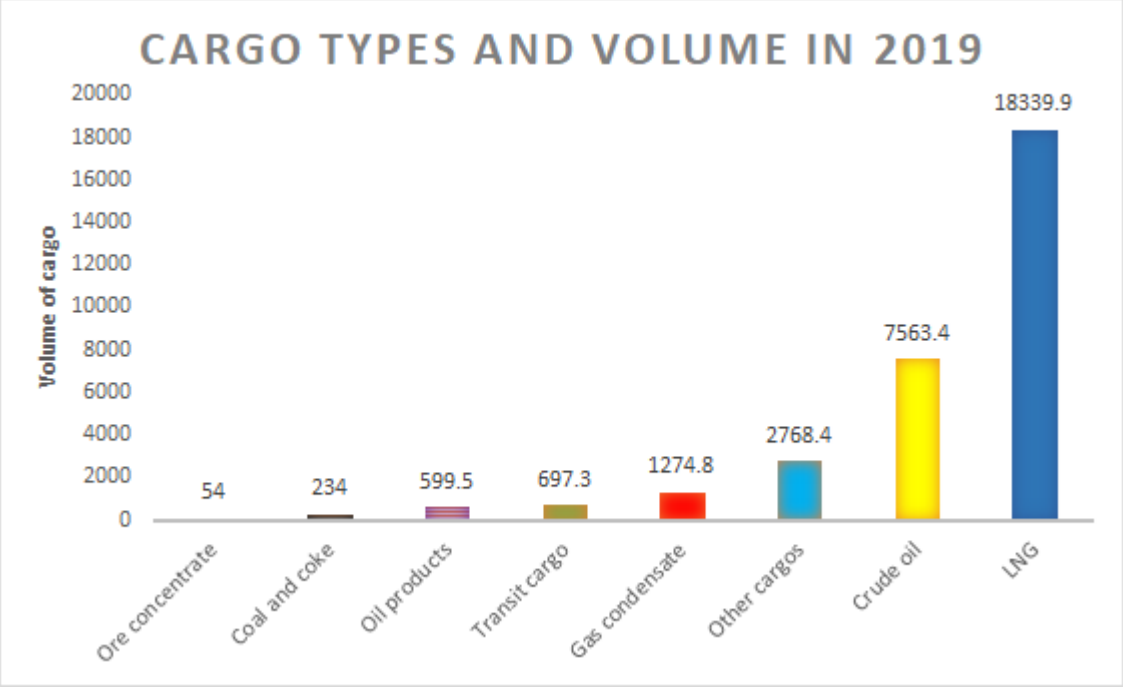


**Figure 4.8: Cargo types and volume along the NSR in 2019**

Source: CHNL

Cargo exports from the Arctic continued to be the guiding factor behind the growth of transportation on the NSR. Oil, LNG, coal, ores and minerals, fish, and timber products will continue to be the primary cargo exported from the Russian Arctic to North-East Europe and North-East Asia in the future. Transport of general cargo and construction materials for large-scale Arctic port and energy projects (for example, the Port of Sabetta and the Yamal LNG in Ob Bay) was also essential, similarly for transporting products and supplies to Arctic ports. Furthermore, cruise tourism was expected to grow in the coming years, especially on the Barents Sea, White Sea, and Pechora Sea (Middleton et al., 2018).

### 4.3.2 Domestic shipping

In this master's thesis, we mean domestic voyages mean the voyages between two Russian ports/locations and voyages between a Russian port and a non-Russian port. As illustrated in Figure 4.9, the NSR has been commonly divided into two parts - the westerns part and the eastern part. The division into two parts is due to the complexity of the ice cover. The western part of the NSR, including the Kara Sea, the Ob Bay, and the Yenisei Bay, has been characterized by the intensive shipping activity between the NSR ports, Arkhangelsk port, and Murmansk port (Gunnarsson, 2021).

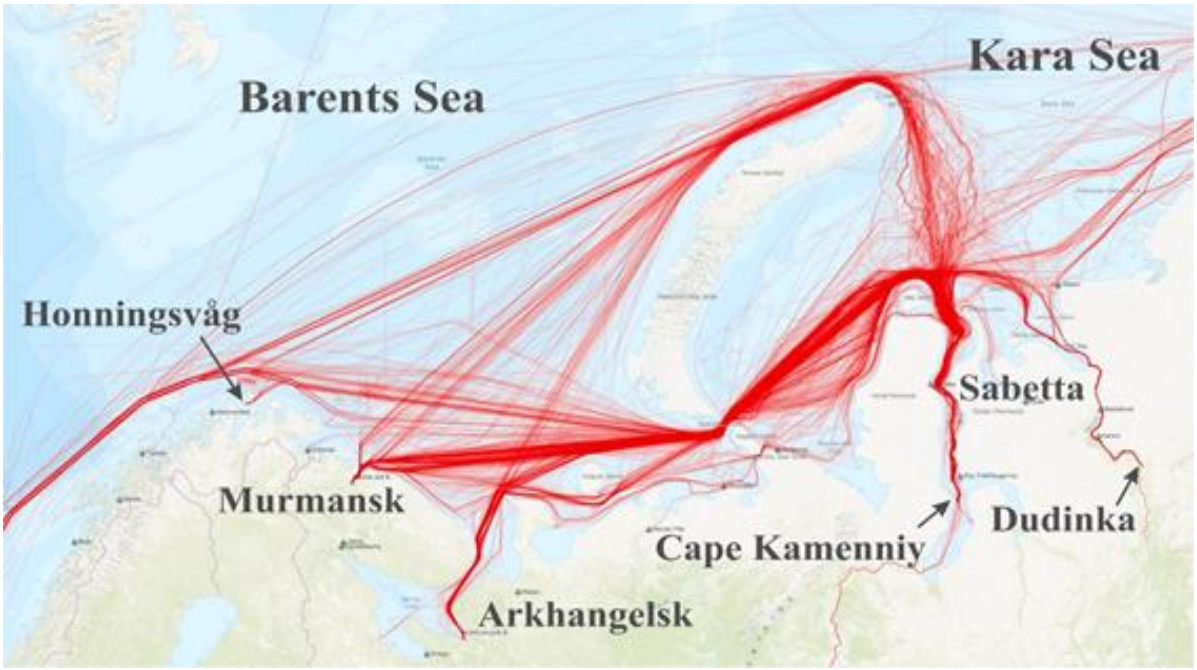


**Figure 4.9: The sailing tracks of vessels in the South West Kara Sea in 2018**

Source: CHNL

Russian nuclear icebreakers assisted cargo ships sailing between the Kara Sea South West and the Ob Bay and the Yenisei River in the winter-spring seasons. Domestic shipping was the most primary form of shipping operation on the NSR, accounting for 87 percent of all voyages in 2016, 92 percent in 2017, 84 percent in 2018, and 76 percent in 2019 (Figure 4.10).

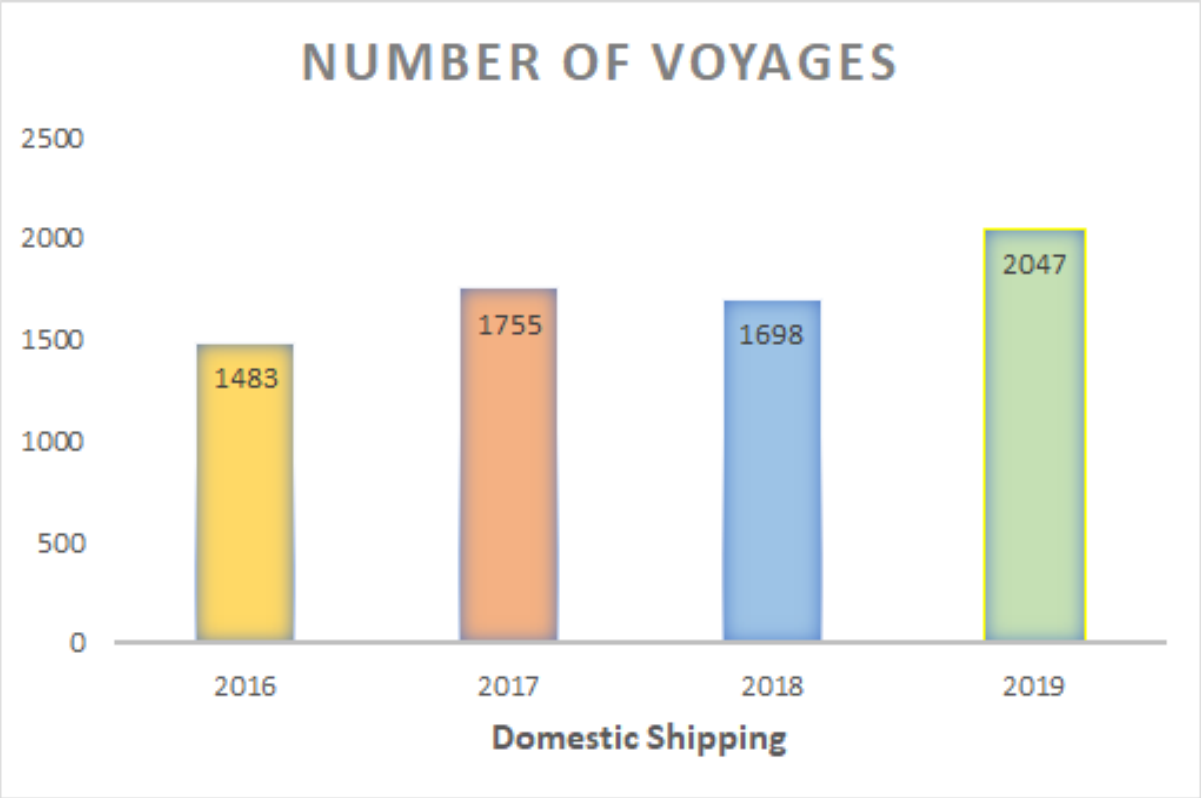


**Figure 4.10: Number of domestic voyages in NSR between 2016 and 2019**

Source: CHNL

Arkhangelsk and Murmansk are two essential operations and supply hubs, and transshipment in the case of Murmansk were either arrival or departure locations for 50 percent of all NSR voyages in 2018 (See Table 4.1.). About domestic port development, Respondent 1 told:

> *"Certainly, High North ports along the NSR are not something new. They have been there since the Soviet times. Many of them were related or appeared due to economic activities like mining activities and LNG extraction. That was wood exploitation and export. There have always been ports that have changed somehow."*

> *"The question now is these ports they're mostly serving the national interest for Russia and military purposes sometimes. So, there will be a discussion on how to integrate them into the international logistic system… There is a simple answer to "does the cargo transportation development via NSR influence the development of the northern port infrastructure?". Besides the investment aspects, there is the market with the solution we propose with international shipping firms to the transshipment hubs connected to the question previously of big companies how to make them use the route. So, they have interconnected: the port development and the international market."*

The majority of the voyages were to or from Sabetta and the Arctic Gate oil terminal at Dudinka on the Yenisei River and Cape Kamenniy in Ob Bay. Crude oil from Cape Kamenniy and nonferrous metals from Dudinka was sent to Murmansk before being exported to European markets. Both Arkhangelsk and Murmansk served as supply points for building materials, machines, supplies for the Sabetta harbor, the upgrade of the Pevek port in the East Siberian Sea, and the construction of numerous remote army bases on Russian Arctic islands and archipelagos. Yana River, Khatanga, Tiksi, Pevek, Dickson at the Kara Sea and Cape Bykov bordering the Laptop Sea, and Cape Zeleniy in the Eastern Siberian Sea were other popular destinations on the NSR throughout the summer and autumn period (See Table 4.1) (Gunnarsson, 2021). As commented by Respondent 1:

> *"About types of cargo for local transport, some discussions about some products like wood, processed wood. However, there were some issues about the cost of using the NSR for this… And besides wood, reindeer meat, and minerals extracted like oil and gas, I would say that it's my perspective of this national or internal traffic that has potential in the current scenario."*

**Table 4.1: The number of port-of-calls and arrivals to Russian Arctic coastal seas and rivers along the NSR.**

Source: CHNL

| Arrival locations | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|
| Kara Sea | 96 | 174 | 185 | 235 |
| Gulf of Ob | 504 | 483 | 558 | 901 |
| Yenisei River | 105 | 97 | 90 | 96 |
| Ob River | 2 | 6 | 0 | 3 |
| Irtysh River | 1 | 7 | 5 | 5 |
| Laptev Sea | 88 | 129 | 167 | 139 |
| Lena River | 25 | 42 | 29 | 26 |
| Yana River | 7 | 12 | 20 | 28 |
| Khatanga River | 2 | 19 | 9 | 12 |
| Anabar River | 6 | 13 | 7 | 15 |
| East Siberian Sea | 76 | 121 | 124 | 138 |
| Kolyma River | 20 | 45 | 58 | 52 |
| Indigirka River | 4 | 0 | 0 | 0 |
| Chukchi Sea | 22 | 56 | 30 | 42 |
| Total number of calls | 958 | 1204 | 1282 | 1692 |
| Different locations | 51 | 84 | 62 | 61 |

The majority of these trips were between Murmansk and Sabetta. The Norwegian companies supplied many offshore service and supply vessels, and the companies in the Netherlands, Luxembourg, and Belgium provided boats, tugboats, and dredgers. During 2016–2017 other non-Russian vessels in domestic shipping involved general freighters, bulkers, heavy lifts, and LNG operators until their first trip from Sabetta, stopping in Murmansk. During this period, Chinese companies made five domestic trips (drilling rigs). The NSR tankers and bulkers were substituted with the low tonnage of container vessels carrying general cargo and project cargoes from Northeast Asia and Northwest Europe.

### 4.3.3 International shipping

In this thesis, international shipping means transit voyages on the NSR are voyages via the NSR crossing both the western and eastern borders of the NSR without calling at ports/locations along the route. After the shipping of iron ore from Kirkenes in northern Norway to Lianyungang in China in September 2010, the number of foreign transit voyages during the summer-autumn season ranged from 1 to 17 per year. Any international NSR transit trip can be viewed as an exploratory or demonstrative journey but an appropriate way of assessing NSR's economic potential as a possible trade route. However, beyond this first phase, foreign transit shipping is moving slowly (Gunnarsson, 2021).

Figure 4.11 illustrates that international transit voyages via the NSR were just 8 in 2016, 12 in 2017, 17 in 2018, and 14 in 2019, or 0.4–0.8 percent of all voyages throughout each year. Over the four years, 47 of the 51 foreign transit voyages transported freight totaling 980,676 tons. The majority of the cargo arrived in Asia (28 voyages, or 60%), mainly in China (19 voyages). There were 29 voyages with general cargo, 4 with paper pulp, and 5 with frozen fish or meat. Four voyages began in Canada, 2 with coal from Vancouver and 2 with iron ore from Baffin Island, Nunavut: 304,699 tons combined (Gunnarsson, 2021).

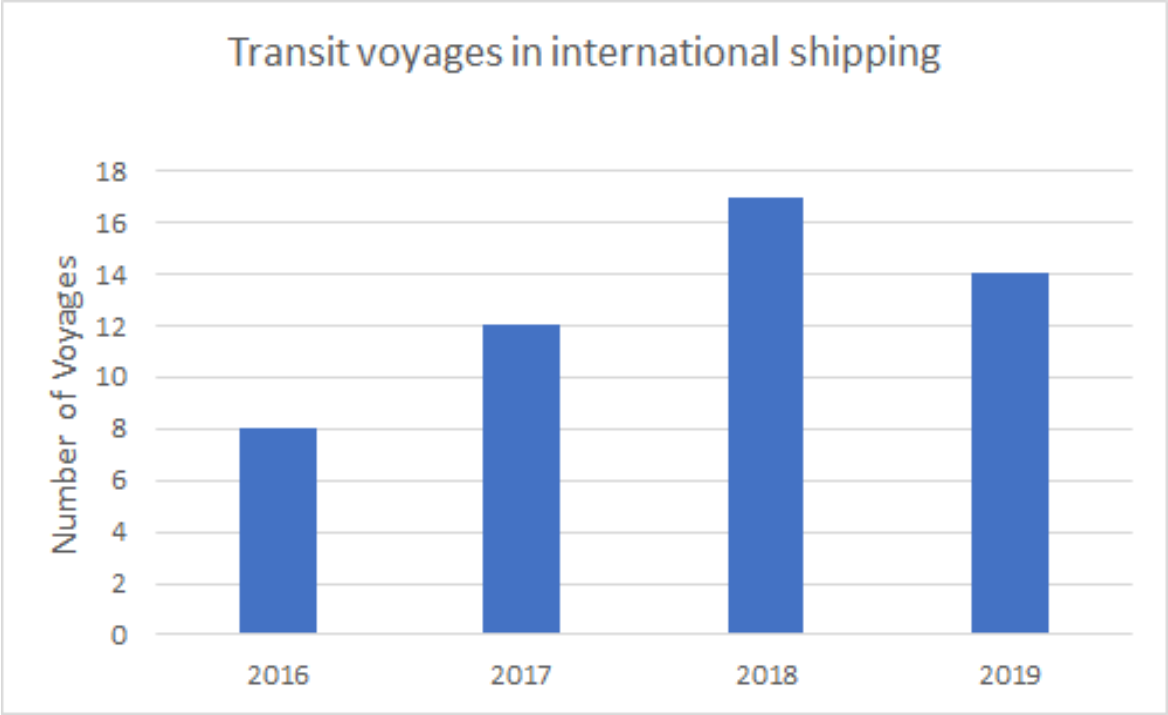


**Figure 4.11: Transit voyages in international shipping along the NSR from 2016 to 2019**

Source: CHNL

Container shipping on the NSR between North-East Asia and Northwest Europe would be needed all year to ensure the route's complete incorporation into the global transportation system. Several scholars have highlighted the difficulties in developing such a container shipping company on the NSR (Lasserre, 2014). One apparent impediment was the ice levels, which were far worse in the eastern section of the NSR during the winter-spring season than in the westernmost part, where year-round shipping is already taking place (Stephenson, Brigham, & Smith, 2013). However, Russia intended to open up the eastern portion of the NSR for commodity transport to the Asian Pacific market over the next 8–10 years, with the assistance of various intense nuclear icebreakers (Gunnarsson, 2021). This opening would be suitable for foreign transits.

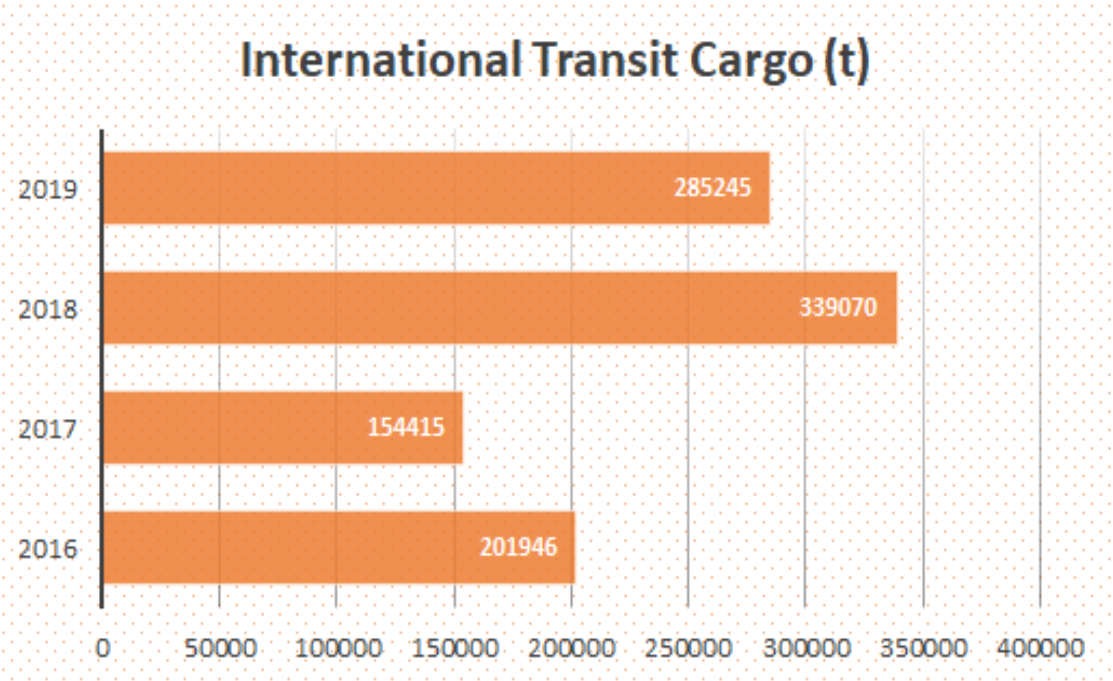


**Figure 4.12: International transit volume cargo along the NSR from 2016 to 2019 (tons)**

Source: CHNL

The majority of the ships had been general cargo and heavy-lift carriers carrying project cargo along with power equipment and wind. During 2016–2019, 51 international transits, 47 of which transported 980.676 tons of freighters (Figure 4.12). Most cargoes came from Asia and mainly China. The majority of 29 journeys were carried by general cargo vessels. In contrast, Nordic shipping firms were active participants in foreign shipping from 2010 to 2013, only Nordic Bulk Carriers (Denmark).

Russia would need to have substantial assistance in supporting international transit shipping, both by direct infrastructure expenditures and developing international collaboration on NSR transit shipping. Russia has begun some partnerships with China's COSCO and Japan's Mitsui O.S.K Lines (Mitsui O.S.K. Lines, 2018). The Chinese group COSCO Shipping Specialized Carriers controlled and ran most ships. Between 2016 and 2019, COSCO accounted for 45% of all international transits, accompanied by 25% German firms (Figure 4.12). In fact, COSCO made two transits in 2019 between western Russian ports and China and Vietnam. All international transits have occurred between North-East Asian Pacific ports (Japan, China, and South Korea) and ports in Northwest Europe (the five Nordic countries, UK, Germany, France, and the Netherlands) (Gunnarsson, 2021).

Russia has had to include reliable communication and navigational support systems for transit navigation, including dedicated icebreaker support (Moe & Brigham, 2017). However, Russia's present and possibly future priority is on its own Arctic energy and resource exploration programs, not serving international vessels on international transit voyages.

## 4.4 Administration and management of the NSR

### 4.4.1 International rules and regulations

The International Maritime Organization (IMO) and the international conventions United Nations Convention on the Law of the Sea (UNCLOS), Safety of Life at Sea (SOLAS), Prevention of Pollution from Ships (MARPOL), and Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) are the major international regulatory bodies related for NSR. Respondent 1 stated that:

> "*International shipping is regulated by IMO. All the agreements on ship emission have to be discussed in the MEPC (Marine Environment Protection Committee), the working group of international regulation on shipping and environmental protection. IMO MEPC approves regulations like the ballast water convention, like the sulfur emission control areas, end of life of ships, etc. The Arctic is a highly political discussion. This is the reason why everything has to be agreed there."*

UNCLOS serves as the primary international legal mechanism for regulating navigation. UNCLOS often leaves the subject with particular concrete rules and requirements to the IMO in the field of shipping. The International Code for Ships Operating in Polar Waters (Polar Code) for ships sailing safely in polar water has been formed by IMO to avoid a potential occurrence in the polar sea ("Shipping in polar waters," n.d.).

The Polar Code is compulsory under the SOLAS and MARPOL international conventions. The Polar Code of IMO came into effect on 1st January 2017, adding new safeguards for vessels navigating polar waters (Figure 4.13) and concerns over environmental protection related to ships in service (Figure 4.14). According to IMO, the goal of the Polar Code is:

"*to provide for safe ship operation and the protection of the polar environment by addressing risks present in polar waters and not adequately mitigated by other instruments of the Organization.*"

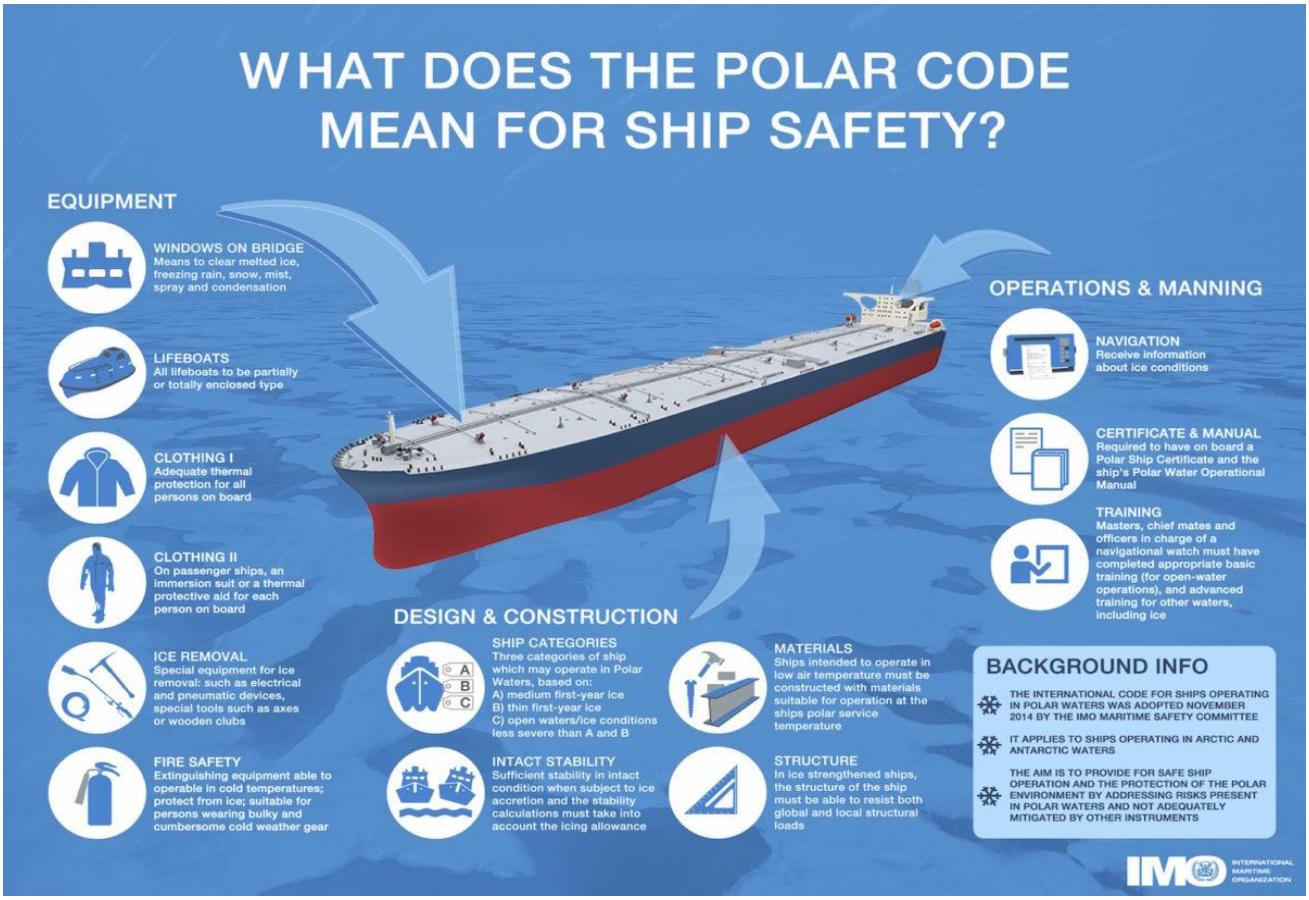


**Figure 4.13: Polar Code Ship Safety**

Source: IMO

In developing the Polar Code, the Russian Federation was a key participant. The Russian Federation made essential contributions to the establishment of polar shipping guidance before the Polar Code. Its contributions have mainly aimed to promote its specific objectives in the field rather than the broader IMO aim of establishing standardized polar shipping standards (Bognar, 2016).

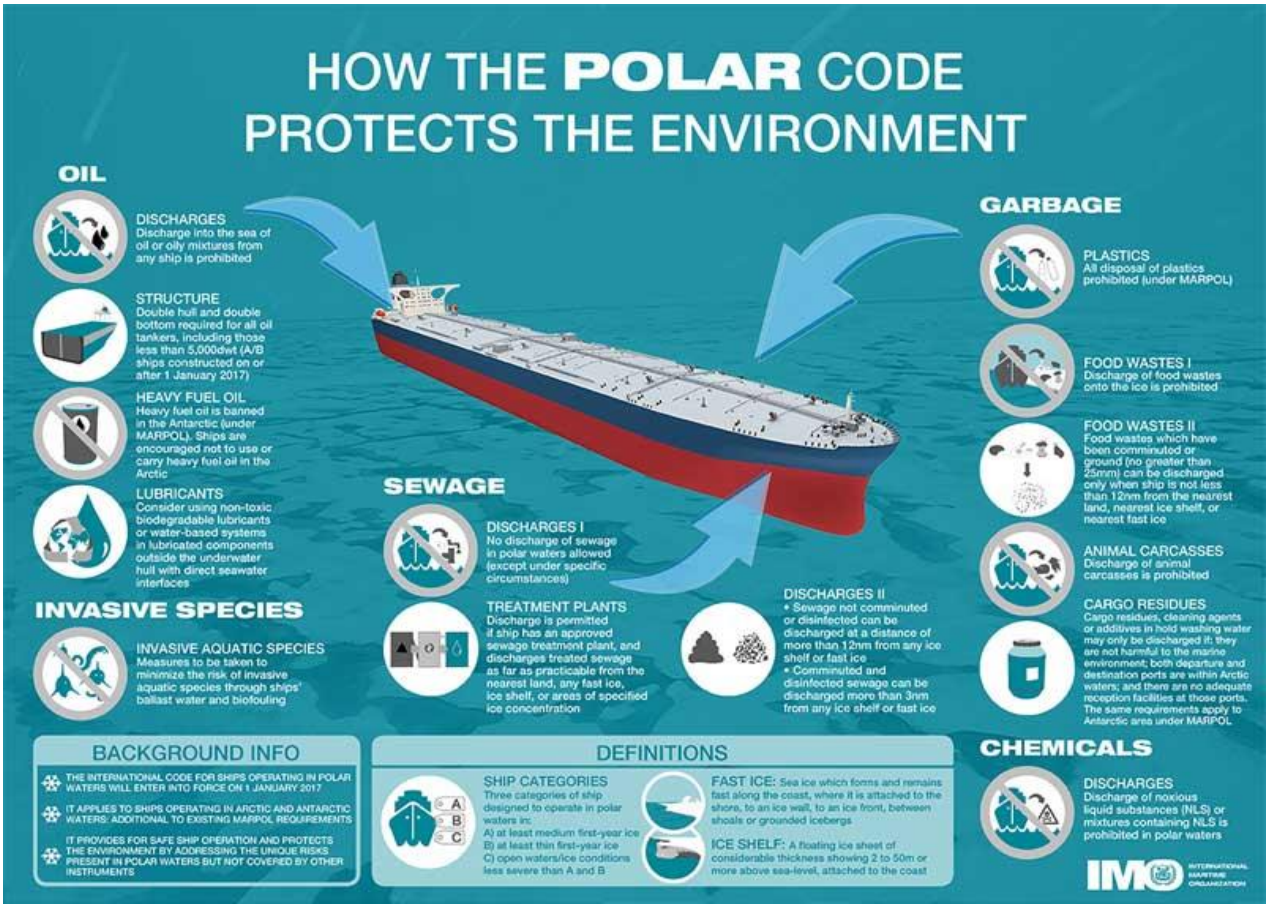


**Figure 4.14: Polar Code protects the environment**

Source: IMO

Over the last years, international law has become more influential in the internal legal system of the NSR. This Polar Code should be strictly adopted by every IMO member state, including Russia. Shortly after implementing the Polar Code, the Russian Federation Transport Ministry made a compulsory condition for issuing a sailing permit via the NSR by having the Polar Code certificates (CHNL, 2018). This is supposed to affect NSR maritime safety positively and lengthy sustainability, minimize risk and bring Russian regulations into line with global standards.

## 4.4.2 Russian Federation rules and regulations

The most significant legislative reform in the legal system of NSR in the last ten years was the implementation of the Federal Law of 2012 ("The Federal Law of July 28, 2012, N 132-FZ ' On Amendments to Certain Legislative Acts of the Russian Federation Concerning State Regulation of Merchant Shipping on the Water Area of the Northern Sea Route,'"

2012). This legislation is the legislative framework for establishing the NSRA and a range of specific navigation rules in the water area of the NSR, 2013 Rules.

The 2013 Rules, the same as the 1990 Rules, defined an authorization-based navigating process supervised by the NSRA, which specified costs for icebreaking and ice-pilotage utilities. They also have several specific procedures and regulations that create the opportunity for NSR to be opened to the global system. In particular, it should be noticed that the NSRA's waiting time has been reduced by at least four months in the 1990 Rules to twenty-fine days in the 2013 Rules to be given permission. Furthermore, requests for permission to sail in the NSR water zone can now be made in the context of a digital form, not telegraphy, and the NSRA's specialists do not have to check the ship, like before. Table 4.2 provides a review of the main modifications to the rules and administrative reorganization introduced in 2013.

**Table 4.2: Comparison of NSR regulations before and after 2013**

Source: Milaković et al. (2018, p. 59)

| **Before 2013** | **After 2013** |
|---|---|
| A sailing permit is required for every vessel planning to sail through the NSR, whether for destination or transit shipping. | |
| The ship's captain or whoever takes his place must have expertise navigating a vessel on ice. | |
| Obligatory necessity to get a Certificate of Civil Liability for oil contamination. | |
| Shipowners planning to operate in the NSR should apply for sailing permission at least four months before for NSRA. | An application for a sailing permit with all required documentation must be e-mailed to the NSRA no earlier than 120 days and no later than 15 working days before the expected date of entry into NSR waters. |
| Ship inspections are obligatory. | No ship inspection is required; just documentation submitted via email is |

| | |
|---|---|
| | required. |
| At a minimum, the vessel's ice-class must be Arc4 or 1-A (for transit). | The system is flexible. Criteria for admission rely on actual ice conditions, season, NSR area, ice cover. |
| Assistance with icebreakers is obligated. | Depending on the ice conditions, icebreaker support can be compulsory or optional. |
| Calculation of the fees of icebreaker support decided to during negotiations. | Calculation of icebreaker support fees using tariff tables, that detail the highest permissible tariffs. Nonetheless, the provider has the right to cut the fee if deemed appropriate. |

With the passing of federal law N 132-FZ in 2012, the rates and procedures defined tax for icebreakers' assistance and the ice piloting of vessels along NSR were changed significantly more by the renewal of Russian legislation. Before this, the Russian Federal Tariff Service decided the limitation of the merchandise transport tariff based upon the kind of freight being transported. For instance, in comparison to timber items, cars would be paid 16 times higher. With this framework, a clear connection between the rate of fees and the extent of the service provided or the environmental hazard has been challenging to see (Solski, 2013).

The 1999 Merchant Shipping Code has been a critical part of the national legal regime of the NSR as a consequence of the 2012 legislative change. Article 5.1, named “Navigation in the area of the Northern Sea Route" is critical to the NSR's legal regime. It defines the guidelines for navigation control, the functioning of the NSRA, the permitting process, and fees.

Respondent 1 told:

> “*Does the current regulations make it easier for international companies to enter the NSR right now? This is a specialized question… Russian Federation went through one of the changes: the institution that they*

*charge of the NSR. They give a larger responsibility to Atomflot, who is in charge of managing the icebreaker fleet. Previously, the responsibility was to be the Ministry of Transportation. So there have been some institutional changes as well in terms of the management of this route. One of the implications is that they want to make it easier for international shipping to use and register the use of NSR to institutional change. There are still barriers like physical barriers: climate, and so on, market barriers: how to make this competitive, and in the meantime, ports to serve. But most importantly is the investment to make this route competitive and safe like navigation aids, risk and emergency preparedness in case this international shipping company uses its shipping route on a larger scale."*

Over decades, the NSR management assigned the Ministry of Transport sole authority for navigation over the Arctic shipping routes remained constant. President Putin, however, signed a law on 27 December 2018, creating a common obligation between Rosatomflot and the Ministry of Transport concerning the NSR management. According to the document, Rosatom acquired authority to develop and control the vessel, infrastructure, and maritime ports all along NSR. In contrast, the Ministry of Transport maintained controls to enact shipping rules covering environmental and safety requirements, permit or reject vessel entry, improve global cooperation, and apply the Polar Code. In addition, in January 2019, it was decided to incorporate Arctic concerns to integrate the increasing growth of regional infrastructure and the industry under the authority of the Far East Ministry. As a consequence, it was called the Far East and Arctic Ministry.

Respondent 1 stated:

*"I'd say there is a strategic interest from Russia for this route. It's been known for a while, not a secret. There have been some actions as well because of the political strategy of Russia. This is seen as an internal route for securing the High North territory and the resource exportation in the High North in Russia, not least for security reasons, military reasons. The openness of Russia to international trade in the 1900s also created this window of opportunities for international shipping as an alternative to the Suez Canal or Panama canal.*"

In 2020, President Vladimir Putin signed several national strategies on further developing the Arctic zone and the NSR. One of these strategies aims to enhance endeavors and the fiscal frame to encourage NSR shipping. It is expected that the NSR keeps on developing in the following decades. This has also been supported by Law #164 on March 05, 2020, "'Fundamentals of the State Policy of the Russian Federation in the Arctic for the Period up to 2035". Another national strategy titled "Strategy for the Development of the Arctic Zone of the Russian Federation and Provision of National Security for the Period through 2035" was ratified in 2020. This strategy points out several social issues, lack of infrastructure, harsh climatic conditions, and sensibility of the Arctic ecosystems. So, it emphasizes the Arctic region's involvement in socio-economic and national security developments. At the same time, many Russian governmental initiatives point out many issues related to the NSR development, including social and societal issues. The overarching aim of Russia is to come up with year-round, stable, secure, and cost-effective navigation via the NSR, along with trans-Arctic shipping.

Respondent 1 once said:

> *"There are talks also to bring the public-private partnership into the creational some of the logistics to those regulatory changes. And there are also discussions about the sanctions on Russia currently and how that affects the development of NSR. Because to develop this infrastructure, besides the political changes needed to give agencies funds or freedom, they also need to attract international investment to confront this infrastructure and promote the route or at least funding the creation of the transshipment hubs. Many initiatives like Petropavlovsk port in the Far East (Kamchatka peninsula) are trying to confront the port development, thereby creating a special economic zone that can attract international investment to these purposes. And those changes, like allowing Petropavlovsk to do this special economic zone area in the port was not possible without the policy changes. So what I can say is certainly policy changes that aim to make this route attract different international shipping."*

### 4.4.3 Northern Sea Route Administration

Federal State Institution “The Northern Sea Route Administration” (NSRA) was established according to the Order of the Government of Russian Federation № 358-p (March,15,2013), Federal Law Act # 81 (April 30, 1999) p.3 art. 5.1 “The merchant shipping code of Russian Federation " to manage navigation in the NSR's water area.

The NSRA is known as the Russian Ministry of Transport entity, which assures NSR shipping managing, maritime safety, and marine environment protection in the NSR from pollution caused by vessels under the NSR Law of 2012. According to the official website of NSRA (“Object of activity and functions of NSRA,” n.d.), below are the primary functions:

*“- Obtaining and considering the submitted applications and issuing the permissions for navigation through the Northern sea route;*

*- Issuing the certificates of the ice conventional pilotage on the Northern sea route;*

*- Researching weather, ice, navigational and other conditions on the Northern sea route;*

*- Coordination of installation of navigational aids and harmonization of regions to carry out hydrographic surveys operations on the Northern sea route;*

*- Assistance in the organization of search and rescue operations in the water area of the Northern sea route;*

*- Assistance in eliminating the consequences of pollution from vessels of harmful substances, sewage or garbage;*

*- Rendering the information services in relation to the water area of the Northern sea route, for example, about the organization of navigation, requirements of safe navigation and others;*

*- Making recommendations about development of routes of navigation and using icebreaking fleet in the water area of the Northern sea route, ice and navigational conditions there;*

*- Timely data retrieval from Russian hydrometeorological service about hydrometeorological forecast and ice analysis.”*

To use the NSR, a shipowner must receive the NSR sailing permission provided by the NSRA and is free of charge. The vessel owner shall apply for navigation permission by submitting voyage information on the NSRA website through the application portal. The NSRA examines the application for sailing permission and decides approximately during ten working days. The requirements for admission are ice conditions, marine areas of the NSR, ice-class, the sailing mode - with or without icebreaker assistance, and the sailing period. Additionally, the requirements can be seen in detail in the "Rules of navigation in the water area of the Northern Sea Route" ("Rules of navigation in the water area of the Northern Sea Route," n.d.). Appendix B presents an example of the permission for sailing within the water area of the NSR in Russian and English that was obtained from the official website of the NSRA. The following information is presented in the permission for sailing in the water area of the NSR:

*"1) name of ship;*

*2) flag of the ship;*

*3) IMO number;*

*4) date of the beginning and end of the permission validity (time of the validity of permission should not exceed 365 calendar days);*

*5) route of the navigation (area of operation) of the ship in the water area of the Northern Sea Route;*

*6) information on the need for icebreaker assistance of ship under heavy, medium, and light ice conditions with the indication of sections of the water area of the Northern Sea Route (south-western part of the Kara Sea, north-eastern part of the Kara Sea, western part of the East Siberian Sea, eastern part of the East Siberian Sea, western part of the Laptev Sea, eastern part of the Laptev Sea, Chukchi Sea) and period of navigation indicated in annex 2 to the present Rules, when the ship is to navigate under the icebreaker assistance."* ("Rules of navigation in the water area of the Northern Sea Route," 2013)

Appendix C presents an example of a refusal permit to navigate in the water of NSR. The most prevalent causes why the NSR permit was refused are: The navigation area intended exceeds the allowable area defined in the classification certificate; several or any of the documents requested have expired; some attachments to the sailing permit application are not given; the application is not improperly completed or filled in; the documents expire before the scheduled NSR navigation date.

## 4.5 Climate and ice conditions in the Arctic

### 4.5.1 Climate change

Climate change and its consequences are the most pressing global issues today. In a research paper by Scott (2020), the graph in Figure 4.15 compares annual temperatures in the Arctic (red) and the rest of the world (gray) to the 1981–2010 average. Figure 4.15 depicts a temperature pattern of the Arctic from 1900 to 2020. The Arctic was relatively cold at the beginning of the 1900s, but it has warmed around 0.7 degrees Celsius over the 20th century. From the 1920s to the 1940s, there was a warm era, followed by cold periods in the early 1900s and the 1960s. Temperatures have steadily been more than 1.0 °C above the 20th century average for the last decade. In particular, October 2015–September 2016 saw the Arctic experience colder temperatures than the previous meteorological year. The unusual Arctic warming from October 2019 to September 2020 was extended to seven years, with the warmest conditions recorded since 1900.

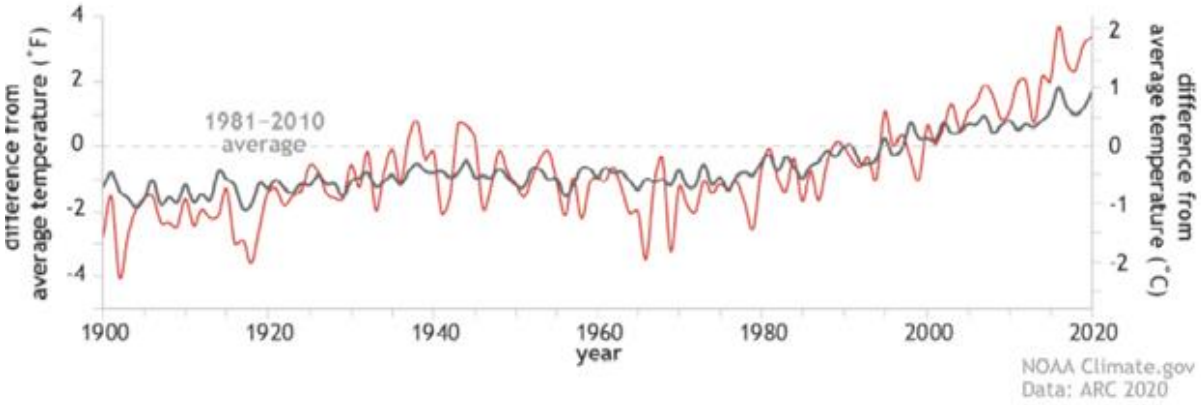


**Figure 4.15: Trends in Arctic temperature, 1900-2020**

Source: NOAA Climate.gov

Arctic temperatures have increased almost twice as high as global temperatures since 2000. Polar amplification—warming that was more rapid in the Arctic than the rest of the world—was compatible with scientific knowledge of the Earth's climate system and global warming model predictions. A variety of factors contributed to Arctic amplification, including heat transfer to the area through atmospheric and oceanic circulation and reduced snow and ice cover. Since frozen ice surfaces reflect the majority of the sunlight that strikes them out into

space, their retreat ensures that Arctic land and ocean surfaces consume more energy and begin to melt (Scott, 2020).

In terms of environment and weather phenomena, the NSR was classified into three areas: the Atlantic Area is covered by the Barents Sea, the western section of the Kara Sea, and a portion of the Arctic basin reaching to the north. Their weather conditions distinguished all three major areas.

The Polar Regions were infamous for dangerous and severe weather, which was frequently inhospitable to humans, and it could cause havoc on equipment. These areas were vulnerable to low atmospheric pressure areas, which were extreme, quickly evolving weather phenomena that bring high winds, heavy snow, and storm surges, in addition to typically windy and cold conditions. These storms could happen upon mariners and made safe travel difficult, especially in narrow, shallow straits where precise and visibility course navigation was critical. This had a direct impact on navigation practicability and safety and the commercial operations of shipping companies.

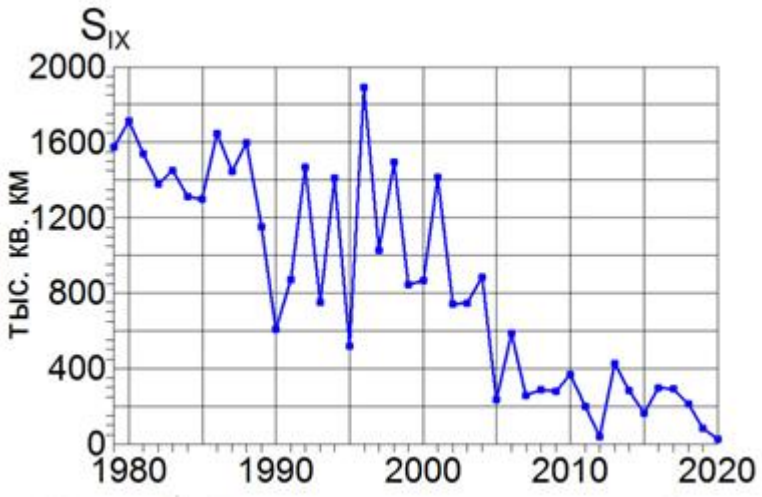


**Figure 4.16: Sea-ice extension along the Northern Sea Route in the period 1976-2020**

Source: thebarentsobserver.com, graph by Roshydromet

The environmental consequences for the Arctic are serious. The melting of sea ice is at an unprecedented pace. The NSR's sea ice-covered only 26,000 square kilometers in September 2020 (Staalesen, 2021). That is the lowest ice level ever recorded in the region at that time of year (see Figure 4.16). However, this is important because it shows some newer navigation and freight transportation opportunities along the NSR.

### 4.5.2 Ice conditions

There has been a significant decrease in the area and thickness of the Arctic sea ice because of global warming. Figure 4.17 presents the actual ice minimum in the Arctic from 2012 (top) compared to the conditions in 1984 (bottom). The level of sea ice in 1984 was approximately the average of the minimum from 1979 to 2000. In 2012, the minimum level of sea ice was about half the average. The Arctic Ocean's ice conditions changed year after year. In research from Cariou, Cheaitou, Faury, and Hamdan (2019), the principal factors affecting transport along the NSR were ice conditions and an element that significantly increases their insecurity.

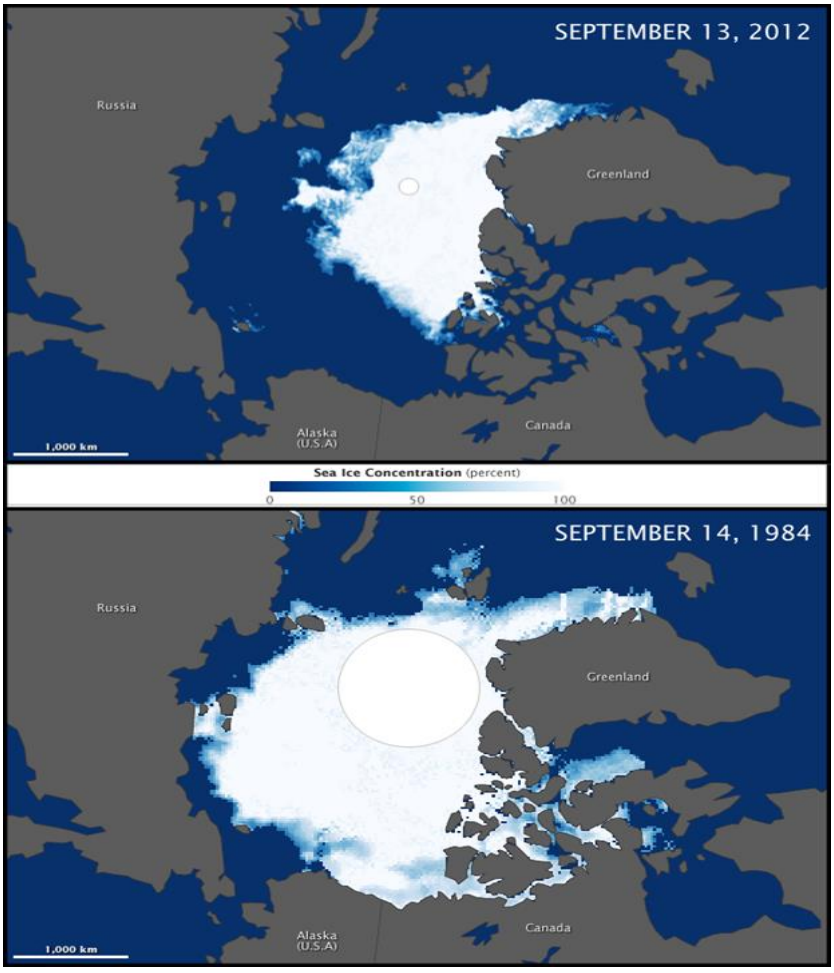


**Figure 4.17: The maps measured demand for the minimum Arctic ice extents in 2012 (top) and 1984 (bottom)**

Source: NASA Earth Observatory image by Jesse Allen

In the current ice conditions during the winter/spring periods, ice-going cargo vessels essential for year-round operations require a costly investment. Further, the ice levels were so challenging in the eastern sections of the NSR that it was doubtful that any procedures were technically feasible in winter. To demonstrate, the ice-going LNG carriers equipped for the Yamal LNG project would only sail westward from Sabetta throughout the winter. The confusion about potential Arctic ice trends was also a significant barrier for shipowners. Shipowners must estimate their Arctic operations for various possible future ice situations, adding urgency to their long-term preparation.

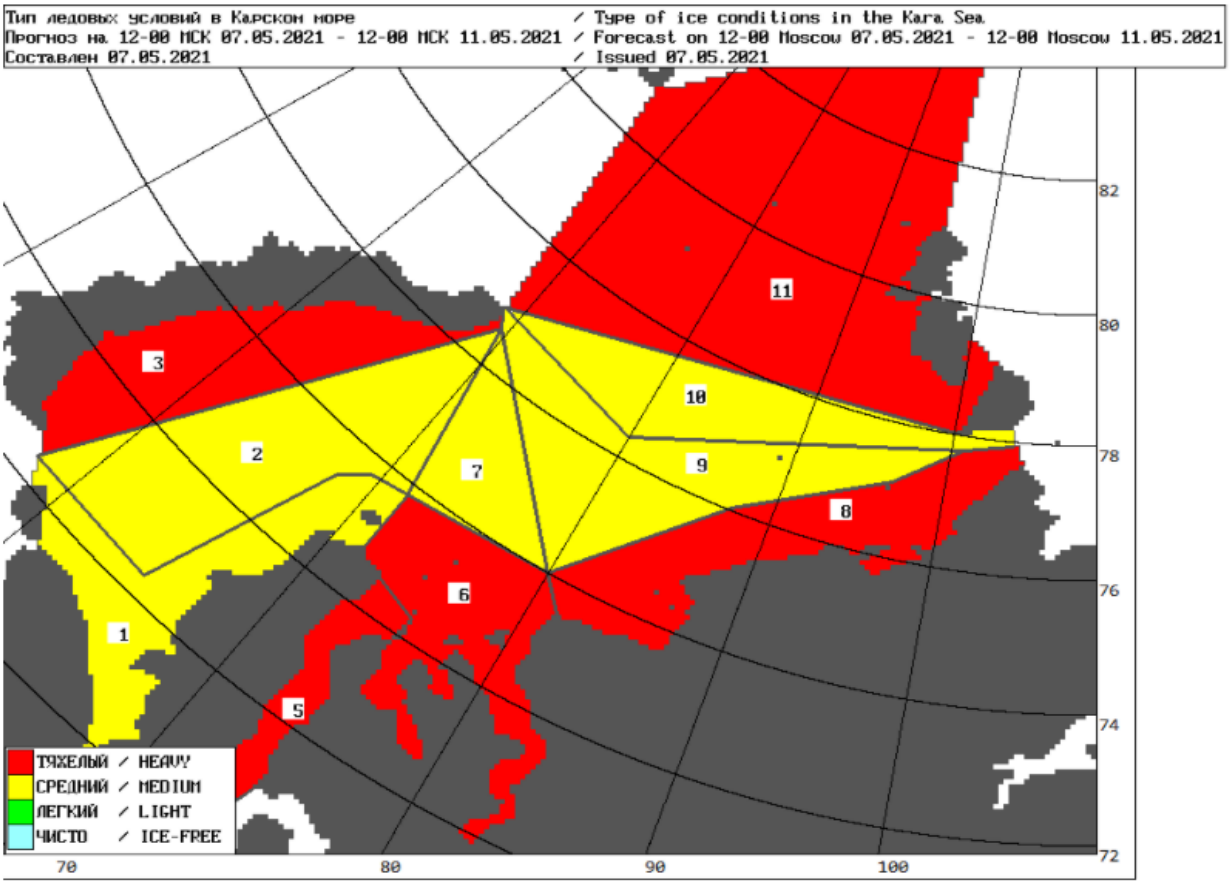


**Figure 4.18: The ice conditions were forecasted from May 7, 2021, to May 9, 2021**

Source: NSRA

NSRA assesses ice conditions along the NSR. The ice charts above were accessible on the NSRA's website and are regularly updated (Figure 4.18). Ice conditions are identified as:

- Heavy: 20 percent more extreme than multi-year averages for some areas of the path and season.

- Medium: multi-year average ice conditions for certain parts of the route and season.
- Low: 20 percent less severe ice conditions than multi-year averages for a particular part of the route and season.

The ship's master could receive current ice conditions and predictions for the scheduled route and evaluate if ice breaker assistance would be needed based on the sailing permit recommendations in the case of ice breaker assistance being optional.

## 4.6 Maritime infrastructure safety and navigation support for shipping along the NSR

### 4.6.1 Icebreaker fleet and icebreaker assistance

#### 4.6.1.1 Atomic icebreaker fleet

The Rosatom State Nuclear Energy Corporation was founded in 2007. The Corporation’s formation created new prospects for advancing nuclear power and technology and a significant expansion of the Corporation's international footprint. Rosatom is now a diversified company, one of Russia's largest, and a world pioneer in nuclear technology. An icebreaker is a special-purpose vessel or boat built to travel and maneuver across ice-covered seas while still providing secure passage for other ships and boats. Russia has the world's largest nuclear icebreaker fleet, which is planned to achieve marine shipping targets in the Arctic using modern atomic technologies. Rosatom is currently the world's only nuclear icebreaker fleet (Table 4.3).

The main activities of ‘Rosatomflot' are icebreaking support to help vessels navigate the NSR and the Russian Federation’s frozen ports, assistance for high-latitude research voyages, and emergency rescue operations NSR frozen oceans. Furthermore, the enterprise provides maintenance and repairs for both their fleet and for foreign ship-owners. It engages in environmental rehabilitation projects in Russia's North-Western area and passenger cruises to the North Pole and the islands and archipelagos of the Central Arctic.

The critical tasks of 'Rosatomflot' are concentrated on maintaining secure and reliable navigation, including transit navigation, via the NSR. Transport to the European and Asian markets for hydrocarbons and other products via the shipping routes of the NSR would offer

a viable alternative to the existing transport routes between the Atlantic and Pacific countries via the Suez and Pacific channels.

**Table 4.3: Rosatomflot's nuclear-powered icebreaker fleets operated on the NSR on December 31, 2019**

Source: ROSATOM, 2019

| **Nuclear-powered icebreaker fleet of Rosatomflot** | |
|---|---|
| Yamal and 50 Let Pobedy, two nuclear icebreakers with 75,000 h.p. two-reactor nuclear power units. |  <br>Yamal<br>  <br>50 Let Pobedy |
| Sevmorput, a nuclear-powered LASH carrier with a 40,000 h.p. one-reactor nuclear power unit |  <br>Sevmorput |

| | |
|---|---|
| Imandra and Lotta, floating maintenance bases |  <br>Imandra<br>  <br>Lotta |
| Taymyr and Vaygach, two nuclear icebreakers with 50,000 h.p. one-reactor nuclear power unit. |  <br>Taymyr<br>  <br>Vaygach |

| | |
|---|---|
| Serebryanka, a motor vessel intended for liquid RAW management and SNF transportation |  Serebryanka |
| Rossita, a motor vessel used for SNF and RAW transportation |  Rossita |

Russian Arctic shipping to be controlled by Rosatom. The State Duma approved the legislation on December 11th and was signed by Vladimir Putin on December 28th. .President Putin signed regulation accomplishing the country's state nuclear power company as the principal provider of the NSR. The new legislation appeared as Russian Arctic shipping was on the rise (Staalesen, 2019).

Cargo transportation in the NSR has become increasingly involved, owing primarily to the icebreaking fleet. The NSR transported 20.1 million tonnes of freight in 2018. In comparison to 2019, the amount of freight shipment has risen by 55%. With the continued construction of hydrocarbon projects in the Arctic, cargo transportation through the NSR is expected to expand steadily in the future. As a result, involvement in Arctic gas and oil projects is becoming a top target for Rosatomflot.

Only a limited portion of ice breaker services are now dedicated to transit shipping around the NSR. However, suppose the number of transit voyages grows in the future. In that case, ice breaker operators may need to find a way to meet local energy developments and trans-Arctic shipping demands. Today, the operators are renewing and upgrading their icebreaking

capabilities. Rosatomflot intends to introduce three additional nuclear-powered icebreakers to their fleet by 2021, each with 60 Megawatt of installed power and the ability to crack ice up to 2.9 meters thick. Plans to build even more efficient nuclear icebreakers of the Lider class, with 110 or 120 Megawatt installed capacity, a diameter of 50 m, and the ability to crack ice up to 4.5 meter thick, have recently been postponed due to budgetary constraints. Nonetheless, constructing an ice breaker with expanded breadth is critical for the potential growth of NSR transit shipping since they will build much wider channels, enabling bigger vessels to join the NSR and benefit from economies of scale ("Nuclear Icebreaker Fleet," n.d.).

### 4.6.1.2 Icebreaker assistance

Most vessels approaching or transiting the NSR would need to be escorted by an icebreaker. Icebreaker assistance is provided by icebreakers authorized to operate under the Russian Federation's state flag. Since nuclear icebreakers have the maximum degree of autonomy and icebreaking capability, Rosatomflot is the only company operating nuclear-powered icebreakers. It is generally used as a convoy escort along the NSR.

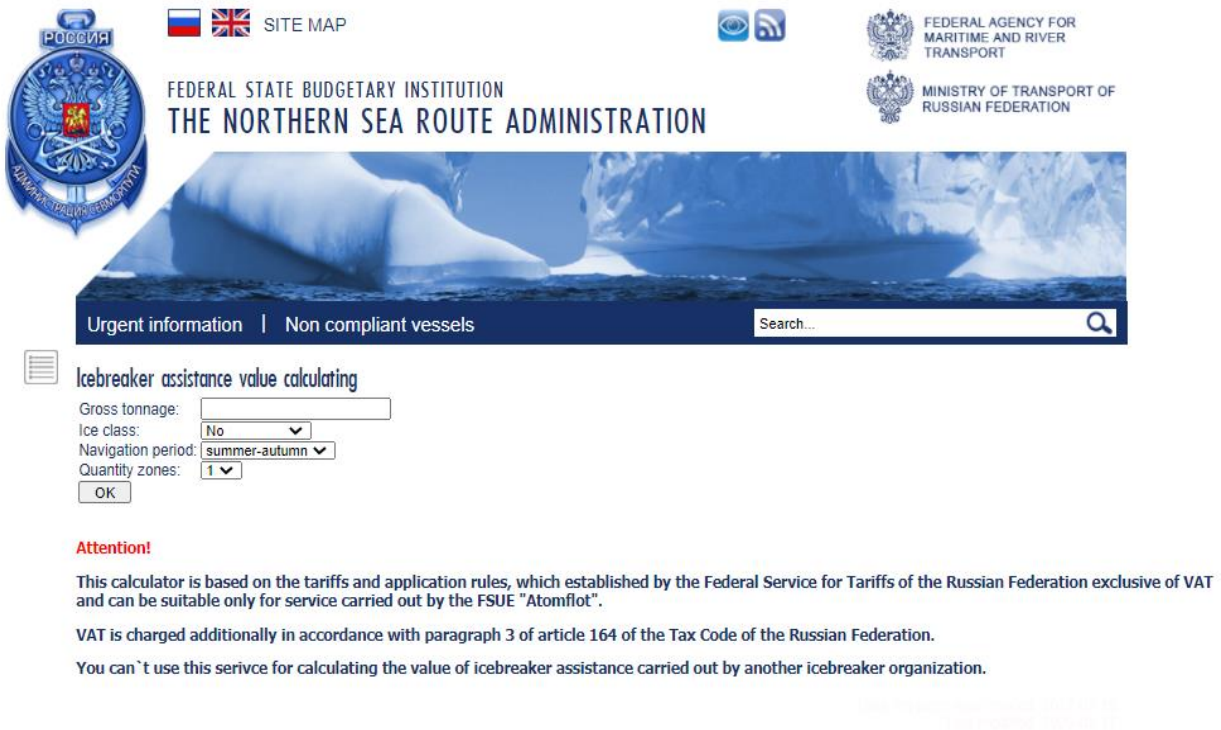


**Figure 4.19: Icebreaker assistance value calculating**

Source: NSRA

Ice surveillance is needed for icebreaker assistance. Icebreakers carve out channels in the ice. This entails forming a fleet of ships to accompany the icebreakers. To ensure navigation safety, ships sail through the channel in tow behind an icebreaker. Radio transmission on channel 16 at a very high frequency is used to communicate with icebreakers and vessels. According to the NSRA website, the icebreaker assistance value calculating tool assists companies in measuring realistic estimates, essential (Figure 4.19).

The fee rate for icebreaker assistance to a vessel in the NSR water region is calculated by Russian Federation legislation, taking into account the ship's capability, ice-class, escorting range, and navigation duration. The point and period of the start and end of icebreaker assistance for a ship are decided upon by the shipowner and the agency providing icebreaker assistance in the NSR's water sector. Respondent 1 told about the tariff icebreaker fee:

> *"There are significant investments in icebreakers as well from Russia. The idea is the new nuclear icebreaker will be servicing NSR so that more ships can use it during the winter months. Still, shipping companies need to pay a fee to use this service, so local cargo does not see this as competitive. This fee was not there in the 1900s; it was introduced in the 1900s, so many local companies in Russian felt that it was an extra cost for using the route, as was the case with wood. "*

### 4.6.2 Ice pilotage

The service of ice piloting played an essential part in the safe navigation of vessels in the Arctic water. Ice pilotage must be present on the bridge if the ship's master lacks adequate skill sailing in ice along the NSR. The sailing permit specifies such a necessity. The ice pilot's assistance is intended to ensure secure navigation across the NSR, avoid collisions, and preserve the aquatic ecosystem in the NSR's water sector. The prices for ice pilotage assistance along the NSR have not been authoritatively calculated. In practice, the service of ice piloting has been paid over $1,000 a day. The NSRA website has a directory of organizations that have ice pilotage services.

### 4.6.3 Safety management on the NSR

#### 4.6.3.1 Search and rescue

The vast region, coupled with inadequate search and rescue (SAR) facilities and severe weather conditions that can trigger long response times in crucial circumstances, presents a significant challenge for active SAR operations in the Arctic. As a result, ships traveling in Arctic waters must have a substantial degree of autonomy. Nonetheless, the SAR infrastructure along the NSR is superior to anywhere in the Arctic water, except for the Norwegian part of the Barents Sea. Four general emergency response centers in Murmansk, Dudinka, Arkhangelsk, and Naryan-Mar have been in service. Moreover, along the NSR, there were many centers devoted exclusively to maritime SAR (Figure 4.20):

- The map of the boundaries of search and rescue region/ of search and rescue sub-regions (SRR/SRS)
- The position of Maritime rescue co-ordination center/ Maritime rescue sub-center (MRCC/MRSC)
- Forward operational location (FOL) with emergency and rescue equipment and oil spill recovery equipment of Federal State Budgetary Institution
- Marine Rescue Service (MRS)

Respondent 3 told about the safety on the NSR:

> *"In my opinion, the normal linear ship is also hazardous to operate in the NSR. Especially since there's an icebreaker service, navigation service in front of them, they need at least some level of ice-class ship operating in that route. It's essential to have some kind of transshipment hubs developed to transship the containers from the normal vessels to ice-class level vessels to operate in different seasons of the year. That is a major impediment for liner service."*

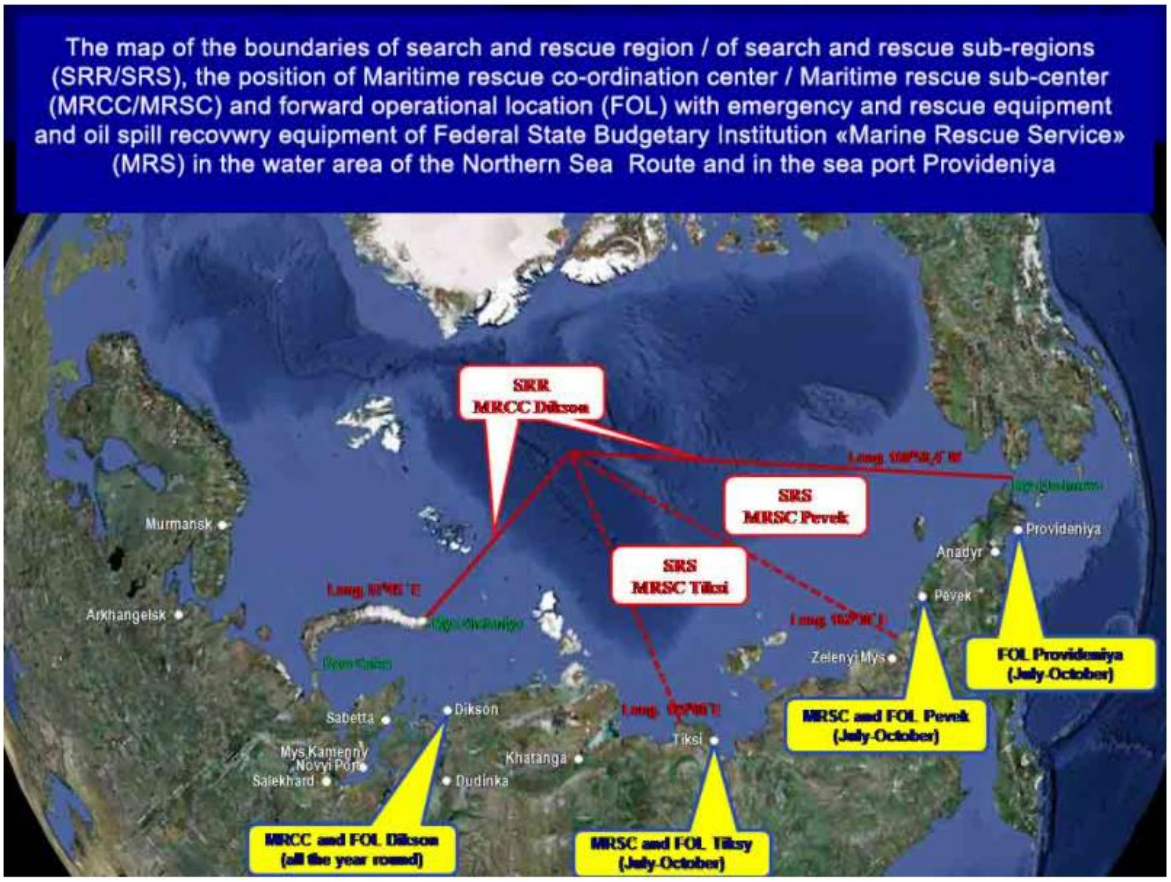


**Figure 4.20: Search and rescue, prevention of pollution by oil in the water area of NSR**

Source: NSRA

### 4.6.3.2 Communication issues and navigational assistance

Communication difficulties on the NSR were primarily since service efficiency dependent on geostationary satellites is diminished while crossing 72°N latitude, and service could not be deemed trustworthy above 75°N latitude. As a result, several signal-enhancement stations have been developed along the NSR, increasing the accuracy of satellite services. Even then, it was not unusual for a satellite signal to be lost in high latitudes, suggesting the need for more service efficiency upgrades. Emergency signals could be received and transmitted for free through radio and coastal stations, unscheduled navigation alerts, and hurricane forecasts to addressees regardless of their position.

Regarding the end of the Soviet Union, state funding for navigational aids plummeted sharply, and the NSR's navigational support scheme worked at the bare minimum of safety

until 2010. The situation has dramatically improved in recent years, with approximately 1240 coastal visual indicators, 730 nautical charts (including 233 in English), and 300 floating markers currently operational for the NSR sector. In terms of hydrometeorological facilities, the NSRA maintains the following details on its website at all times:

- Forecasts of sea ice conditions for the short-term.
- Seasonal predictions of sea ice conditions inside the NSR's seven maritime zones for the first and second summer/fall navigation periods.
- Synoptic charts (forecast and diagnostic) depicting the distribution of air pressure, wind, precipitation, ocean current, wave height, and weather in Russian Arctic waters.
- Charts of sea ice for the NSR's water region.

#### 4.6.3.3 Preparation for an oil spill

Because of the Arctic ecosystem's vulnerability, oil spill preparedness (OSP) was an essential component of the NSR's logistics framework. The existence of sea ice affects the actions of oil spills (Afenyo, Veitch, & Khan, 2016). In the event of an oil leak, Russian state regulations force operators to compensate for the expense of cleaning operations and environmental impact. The effects of an oil spill on the aquatic ecosystem within the NSR field were measured using formulas authorized by Russia's Ministry of Nature Resources and Ecology and the Federal Agency of Fisheries (Bambulyak, Ehlers, & Sydnes, 2014).

If an oil spill from a vessel inside the NSR region, the MRS handles both response and recovery operations. The ports of Dikson, Tiksi, Pevek, and Provideniya are provided with oil spill emergency equipment. Nonetheless, the ice breaker was the most potent part of the Russian OSP system since they were supposed to be the first to arrive at the location of an oil spill.

#### 4.6.3.4 Violates safety rules

The Russian NSRA reported 88 violations of its Rules of Navigation performed by 84 vessels within the first ten months of 2017. This accounts for about 15-20% of all ships sailing the path in the summer of 2017. Violations varied from technical violations such as

failing to alert officials while entering and leaving the route to variations from the authorized route or entering the route without authorization and working in ice conditions that violate vessel requirements.

Over the last decade, the NSR has seen several incidents and accidents. Relevant ice classifications, on the other hand, would help to reduce the occurrence of injuries. In July 2010, the Indiga and the Varzuga, two completely loaded Russian tankers, crashed in medium ice conditions and poor visibility. Due to their ice-classification solid 1A Super with a double hull, neither ship lost seaworthiness, and no oil spills were announced. The tanker Nordvik was hit by ice in September 2013 and began to take on water before the crew avoided the ingress. The ship, which was only permitted to navigate in light ice, was operating in medium ice conditions at the time, demonstrating the significance of ships not operating in waters that surpass their ice classification.

**Figure 4.21: An icebreaker tows Sparta III across the ice**

Source: Ministry of Transport of the Russian Federation

In March 2017, a bulk carrier operated by Danish shipping company Nordic Bulk Carriers collided with Russia's Rosatomflot's atomic icebreaker Vaygach while transiting the Northern Sea Route. According to the information provided, neither vessel sustained any

damage that would endanger its seaworthiness or pose a danger to the ecosystem, and neither vessel's operational schedule was impacted (World Maritime News, 2017).

Violations of safety persist unabated throughout Russia's NSR. The four-week saga involving the rescue of Sparta III, a general cargo vessel with a light-to-medium ice classification, was only the latest illustration of how shipping companies disregard proven maritime laws in the Arctic and confront minor consequences from government regulators. On December 15, Atomflot, which typically operates icebreakers along the NSR throughout the winter, received a request for assistance. After more than a week of consultations, Atomflot agreed to divert one of its nuclear icebreakers, Vaigach, from daily icebreaking operations along the NSR on December 24. The icebreaker had liberated Sparta III after 19 hours, and Vaigach had returned to their usual contractual duties along the NSR (Humpert, 2021) (Figure 4.21).

## 4.7 Experience of the industrial and international companies in using the NSR for freight transportation

### 4.7.1 Russian experience

In early 1990, the Soviet Union's disintegration and the former Soviet Union's socio-economic recession had a detrimental effect on the growth of the NSR. By 2003, the volume of NSR cargo transported was five times lower (1,7 million tons) than during the Soviet Union era. Throughout this time frame, Norilsk Nickel accounted for the majority of freight transportation with 65%.

Nornickel is the Russian mining and metals leader, palladium and refined nickel producer, and one of the largest manufacturers of platinum and copper. There are the two primary exported products to other areas by the Yenisey River and the NSR. The experience of Norilsk Nikel should be taken into consideration.

In expectation of growing demands for icebreaker services, Norilsk Nickel began in 2006 to build its fleet of ice-breaking cargo ships, which are already in use. Their fleet ensures frequent transportation connections during the year between NSR seaports. In 2017, Norilsk Nickel opened a new Murmansk terminal. The firm has doubled its shipping between

Dudinka, the Yenisei river, and Murmansk with the new infrastructure. At the opening ceremony, Senior Vice President Sergey Baterkhin claimed:

> "*With this, we complete one of today's biggest investment projects in the Arctic."*
>
> *"It shows the importance of the Northern Sea Route as a key transport route for Norilsk Nickel and the company's determination to invest in enhanced transport accessibility in the Arctic,"* he added (Staalesen, 2017)

Vladimir Potanin, Nornickel's President, said:

> "*Norilsk Nickel is one of the pioneers in the development of the Arctic, a company with unique experience in operating the Northern Sea Route. We will share it for the further development of this unique route*" ("DP World to operate ports along Russia's northern sea route," 2019)

## 4.7.2 International experience

### 4.7.2.1 Beluga Shipping GmbH

Since World War II, not any international merchant ships have sailed this NSR route, and the Russian government has not even permitted any to try. The Russian authorities were enabling Atomflot to provide offers to lure clients from 2009. By the end of August 2009, Beluga Shipping of Germany sent two cargo vessels from South Korea to Ob Bay via the Bering Strait west, in which 44 heavy-lift modules intended for a power plant were delivered. The connection between continents is nothing revolutionary in the marine sector, but it is a milestone using the quick cut across the Arctic Ocean. To talk about the experiences of using NSR before, Niels Stolberg, the President and CEO of Beluga Shipping GmbH, said:

> "*We are all very proud and delighted to have successfully transited the legendary Northeast-Passage and delivered the sensitive cargo safely through this extraordinarily demanding sea area with discharging in Siberia what itself meant filling a niche in a niche market."*

> *"To transit the Northeast-Passage so well and professionally without incidents on the premiere is the result of our extremely accurate preparation as well as the outstanding teamwork between our attentive captains, our reliable meteorologists and our engaged crew. Before the final cargo was discharged, we had already succeeded in passing any inspections and clearances as well as having been granted the official permission, which also is a great achievement. The challenges of an intense preparation and planning for such a project could all be exemplarily mastered by an ambitious teamwork of which I am very proud indeed"*, he added ("Beluga Shipping masters first commercial transit of the Northeast-Passage," n.d.).

Niels Stolberg answered the question in an interview with PortNews about the traffic prospects of the NSR:

> *"It is our intention and indeed part of our commercial strategy to make use of the temporarily accessible Northern Sea Route during the summer navigation time as regular as possible over the years to come. Subject to the official approval by the Northern Sea Route Administration, we will then probably deliver project cargo to Siberia again as in 2010 and 2009. From a commercial perspective and not least taking into account that using the Arctic Shortcut saves CO2 emissions by reducing the bunker consumption compared to the Suez Canal route, we do, of course, hope that the economically most attractive Northern Sea Route becomes an area of growing traffic opportunities. This would be important for a specialized carrier such as Beluga Shipping since particularly the rising project and heavy lift market in Siberia offers a lot of business chances both for shipping companies and the local economy."* (Chernov, 2011)

#### 4.7.2.2 Maersk

Over the last decade, international usage of the NSR has grown - but not as many people predicted it.

Maersk is a Danish integrated shipping firm operating in the transportation of seas and inland cargoes and related facilities, including supply chain management and port management.

Since 1996, Maersk has been the world's leading container shipping line and ship operator. The company is headquartered in Copenhagen, Denmark, and employs about 83,000 people worldwide, with branches and offices in 130 countries (Maersk, 2021).

On 28 September, Venta Maersk completed its NSR trial passage with 660 reefer containers from Busan to Bremerhaven (Figure 4.22). The trial was intended to provide the organization with operational knowledge along the Arctic route, evaluate vessel systems, crew capacity, and shore support features. Before sailing, the crew of Venta Maersk was specially trained and accompanied during the whole transit by NSR qualified ice pilots.

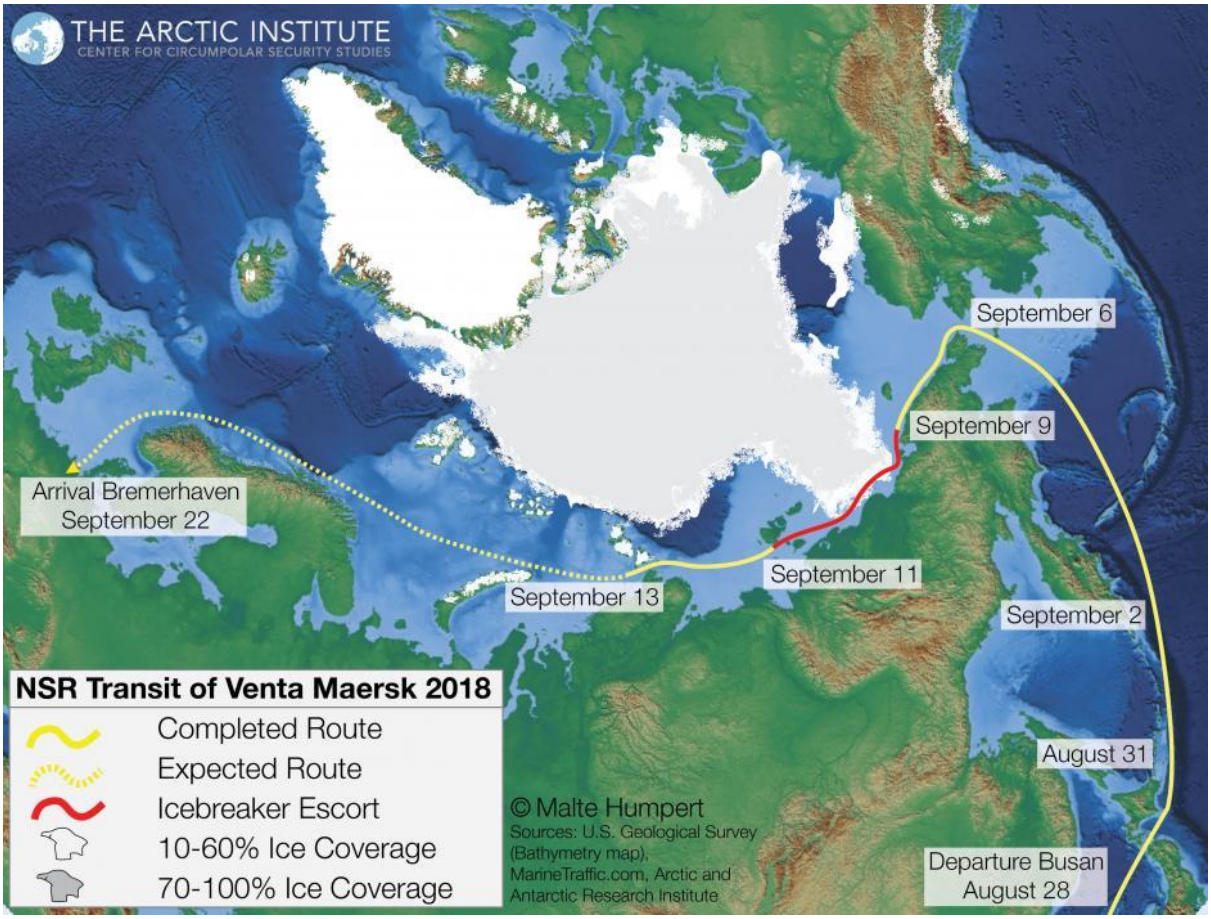


**Figure 4.22: The voyage of the Venta Maersk from Asia to Europe and ice conditions along the NSR**

Source: (Humpert, 2019)

Maersk emphasizes that this was a one-off test intended to acquire operating experiences in a new field and experiment with ship systems. Palle Laursen, Chief Technical Officer at Maersk, stated that:

> *"That said, we do follow the development of the Northern Sea Route. Today, the passage is only feasible for around three months a year which may change with time. Furthermore, we also must consider that ice-classed vessels are required to make the passage, which means an additional investment."* (The Maritime Executive, 2018)

The Northern Lights appeared many times along the trip (Figure 4.23). Captain Søren Bruun indicated:

> *"The memory that will last the longest for most of the crew will certainly be the undiluted experience of nature. Most had never seen northern lights, and we had four days of perfect floor seats to this spectacular show"* (gCaptain, 2018)

**Figure 4.23: Maersk's container ship Venta Maersk sailing along the NSR under the aurora borealis**

Source: Maersk

When the trial trip was over, Palle Laursen, Chief Technical Officer at Maersk, said:

> *"Currently, we do not see the Northern Sea Route as a viable commercial alternative to existing east-west routes."* (Port Technology International Team, 2018)

Michael Meisel, Senior Marine Specialist and project lead of the trial, also confirmed:

> *"New services are planned according to customers' demand, trading patterns, and population centers. Many different factors are taken into account when planning shipping routes, especially trading patterns and population centers."* (Humpert, 2018)

However, in 2019, the company intimated that:

> *"has experienced a growing demand for transport of goods from the Far East to West Russia, which we are currently exploring the possibility of offering together with Atomflot."* (Humpert, 2019)

Through the sharing of people working in Maersk, it can be seen that they intend to return to NSR someday.

# Chapter 5. Analysis and Discussion

Chapter 5 summarizes and analyses our empirical findings provided in Chapter 4. The structure of this chapter is presented according to our four research questions. This chapter provides deeper insights into container shipping as a sustainable solution for NSR freight transportation. The chapter includes five main sub-chapter: the summary of the findings, the economic feasibility of NSR maritime freight transportation, the environmental aspect of NSR maritime freight transportation, the social aspect of NSR maritime freight transportation, and container shipping as a sustainable solution for NSR freight transportation.

## 5.1 Summary of the findings

Table 5.1 provides a summary of our empirical findings. This table shows the overview of characteristic features of domestic and international shipping along the NSR. Freight transportation along the NSR is increasing rapidly. Our investigation has highlighted this development is driven by many beneficial factors. Due to the apparent decline in sea ice thickness and extent, this benefit is now more apparent than it was in the past. However, there are still many challenges ahead. Unpredictable and harsh weather conditions make navigation in the water area of the NSR dangerous for vessels.

Our findings have revealed such a strict abundance of regulations and norms of sailing within the water area of the NSR. However, each year several ships - both domestic and international - violate safety rules. This is also one of the challenges to the development of NSR maritime freight transportation.

Our study has emphasized that NSR freight transportation itself is a social-economic system. Maritime freight transportation across the NSR is the primary way of delivering natural resources originating in distant Arctic areas. In addition, it is also the only way to transport goods and essentials such as medicine and food to the indigenous inhabitants living in the remote Arctic.

**Table 5.1: Overview of the Empirical findings**

| | Domestic shipping | International shipping |
|---|---|---|
| **Main characteristics** | voyages between two Russian ports/locations and voyages between a Russian port and a non-Russian port | voyages via the NSR crossing both the western and eastern borders of the NSR without calling at ports/locations along the route |
| **Actors** | The Russian authorities, Rosatomflot, domestic industrial and shipping companies, oil and gas companies | International shipping companies |
| **Challenges** | - Ice thickness<br>- Unpredictable and harsh weather conditions<br>- Regulatory procedures<br>- Violates safety rules<br>- Icebreaker fees<br>- Communication difficulties - satellite signal lose in high latitudes<br>- Lack of infrastructures | |
| **Benefits** | - Climate change - ice reduction<br>- Technological developments - high ice-class vessels, innovative icebreaking technologies<br>- Rich in natural resources - many new energy projects<br>- Government support - less complexity of the norms<br>- World's largest nuclear icebreaker fleet | |
| **Recently tendency and reasons** | *Increasing*<br>Reasons:<br>- Dominant voyages<br>- Many natural resources - stable extraction of natural resources, production of non-ferrous metals<br>- Oil and LNG projects | *Slightly decreasing*<br>Reasons:<br>- Unfavorable regulation<br>- Heavy ice conditions<br>- Icebreaker fees<br>- Ice breaker needed<br>- Unfamiliar experience of permitting process |
| **Administration and management** | - International: IMO - Polar Code<br>- Russia: NSRA and Rosatomflot | |
| **Mandatory conditions** | - Apply for permission to navigate and obtain permission from NSRA<br>- Icebreaker assistance - if the permission stated (excepting Norilsk Nickel's vessels) | |

## 5.2 Economic feasibility of NSR maritime freight transportation

Historically the economic aspect plays an important role. Previous research from Lun et al. (2010) stated that maritime freight transportation guides the country's economy. The freight transportation of the NSR has historically been a crucial element of Russia's economic development strategy in the High North (Tarasova, 2014). Our findings have revealed several outcomes of how the NSR maritime freight transportation has contributed to the economic aspect of sustainability.

Global warming has increased the melting of ice in the Arctic region. As a result, more favorable conditions for sailing through the NSR have been formed. However, our investigation has identified that there are still some challenges like ice conditions, unpredictable and harsh weather, short navigation period - mostly during summertime, lack of infrastructure. All of these make freight transportation in the ice-infested waters very dangerous. In this light, our findings are consistent with Trukhanova (2014) that the development of freight transportation along the NSR still faces enormous navigational dangers. Our findings have emphasized that the harsh climatic Arctic conditions have always affected the vessel traffic on the NSR. The unpredictability of climatic and ice conditions change poses a considerable barrier to shipowners. Shipowners need to examine their activities in the Arctic for many expected ice conditions, bringing more uncertainty to their long-term preparation.

We have found that the freight transportation voyages have been dominated by domestic shipping. Ship activities along the NSR generally have experienced an increasing tendency. One of the main driving forces for the current increase in freight transportation along the NSR is new energy projects and other activities related to the extraction of natural resources in the Russian High North. As we described in the empirical part (see Chapter 4.3), freight transportation is characterized by a considerable variation of vessel types. The primary vessel types are container vessels, offshore supply vessels, tankers (oil, chemical, and LNG), general cargo vessels, and bulk vessels. According to our findings, the NSR freight transportation appears to be used nowadays mainly by LNG vessels. From the economic aspect, oil and LNG projects located in the Arctic are very profitable, and the usage of northern maritime routes for freight transportation is natural. At the same time, it looks like

container vessels are more beneficial, according to our respondents. Our findings have clearly shown that the NSR's western area has witnessed the most freight transportation activity in the current years. Murmansk and Sabetta's ports play vital roles in services, supply, and transshipment centers for NSR freight transportation ships. The development of domestic freight transportation has been quite intensive because of the industrial operation of local companies – e.g., Norilsk Nickel, oil and gas companies, and other extractive industries located in the Russian High North. Our investigation has emphasized that the NSR is the only way to deliver their finished products and receive suppliers for industrial and social needs.

In light of international transit shipping, the Russian authorities have made extra efforts to attract international companies to use the NSR by improving the regulations and norms. At the same time, as our findings have shown, transit shipping remains still typically modest. It looks like the economic feasibility is low for international companies. Based on the empirical findings, the international freight transit voyages and cargo volume increased between 2016 and 2018 and then decreased in 2019. This has shown that the tendency of shipping transit voyages is unpredictable and flimsy. Our investigation has indicated increased interest in developing sailing operations along the NSR by Asian companies, particularly China, South Korea, and Japan.

Our empirical part has illustrated that recent amendments in the Russian legislation have considerably affected the existing practice of sailing along the NSR and did a favor for further NSR maritime freight transportation development. While still complicated, the regulations and norms play a significant role in developing NSR freight transportation, attracting many domestic and international companies. Our findings are consistent with Seuring and Müller (2008) theoretical assumptions on the driver of sustainable practices since they see government regulations as the most crucial driver. The economic aspect plays a vital role for all actors interested. Our study has found that Russia has recently increased revenues from the region's development. This is compatible with the research by Pagell and Wu (2009) that a sustainable supply chain economically feasible should boost profitability.

In comparison to the Suez Canal, the rate of transits via NSR is minor. Our empirical findings have revealed that there are many reasons for low freight traffic along NSR, such as short navigation for five months because of the threat of ice; lack of freight loaded and discharged northern ports due to low demand; additional navigational threats, including

limited chart coverage, lack of SAR equipment, ice navigation hazards; icebreaker assistance. That thereby results in very high costs for freight transportation international companies to prepare vessels (making ice-strengthened) for sailing within the water area of the NSR. This makes the usage of the NSR for freight transportation not so attractive for international shipping companies. However, after the Suez Canal was blocked by the largest containership and numerous vessels were stuck at both canal ends in March 2021, international trade chains stalled because this is traditionally the main sea route from Asia to Europe and vice versa. Our study has highlighted that the NSR can be considered a worthy choice and an alternative route parallel to the Suez Canal between Northeast Asia and Northwest Europe. This can help the freight transportation industry develop sustainably and not be easily interrupted by any potential accidents. Our findings have shown that the Russian authorities have to provide robust assistance in promoting international transit shipping by increasing NSR infrastructure and global partnership investments.

## 5.3 Environmental aspect of NSR maritime freight transportation

Our findings have revealed several outcomes of how the NSR maritime freight transportation has contributed to the environmental aspect of sustainability. We have found that the environmental improvements started with vessels' new technologies and shorter distances across the NSR will reduce global CO2 pollution. Global warming has increased the melting of ice in the Arctic region. As a result, the beneficial effects of climate change on the NSR freight transportation development have increased cargo over the years. However, it is found in the study that it also has a negative impact on the vulnerable Arctic ecosystem, such as ballast water, local emissions, and oil spill risk. This is compatible with the research by Sigmar et al. (2014) findings that the environmental aspect can have a considerable impact, both positive and negative.

Our findings have suggested that the NSR is still restricted to international freight transportation for only six months a year. We have found that it is a significant impediment for liner shipping service. The regular liner shipping is hazardous to operate in the NSR, so it needs at least some ice-class ship operating in that route. Transshipment hubs are essential to transship containers from normal vessels to ice-class level vessels to operate in different seasons of the year.

As we described in the empirical part (see Chapter 4.5), several violations were recorded in the NSR waters, such as failure to inform authorities before entering and leaving the route, operation in ice conditions exceeding the ship's requirements. This demonstrates that failure to meet maritime safety rules causes high environmental risks for NSR freight transportation development. Furthermore, our findings have emphasized that the rescue operation costs enormous money and time because of the risky ice conditions. According to the data we found, the vessel's cargo of several containers got stuck in the NSR for many days due to violations of safety rules while operating. It means that freight transportation companies would suffer significant damage, and their customers would be forced to wait for an extended period, affecting the economic feasibility. Our findings are consistent with the research of Heyningen et al. (2014) that increasing environmental and economic awareness will benefit shipping companies operating on maritime freight transportation along the NSR. At the same time, we looked at the example of some icebreakers involved in rescuing vessels, and they took four weeks to escort the vessel to safety. Our investigation has emphasized that it takes a lot of time and effort to rescue a ship in case of an accident. What if any more accidents happen contemporary? It seems that the rescue team will not be able to help multiple ships that have accidents at the same time. Our findings are consistent with Danilov et al. (2011) that increasing maritime traffic inside the NSR raises the potential of accidents, representing more environmental risks.

Moreover, our discussion with several researchers during our focus-group interview has highlighted that ships always impact the environment and especially the vulnerable habitat in the Arctic. Our empirical part has illustrated that most vessels operating in NSR are currently equipped with pollution prevention technologies to deal with threats. Still, those types of equipment may not meet the safety requirements for NSR freight transportation. This is a significant problem that needs to be addressed, and shipowners should be aware. The IMO Polar Code has been in force since July 2018, providing additional safety-related navigational aids and protecting the polar environment by addressing risks present in polar seas. Our empirical part has illustrated after the Polar Code in force, fewer accidents in the Arctic Ocean, and shipowners are more aware of the importance of protecting the living environment while operating maritime freight transportation along the NSR. Thus, the regulations of the Polar Code and Russian laws should always be followed by shipowners to minimize the impact of freight transportation along the NSR on the environment.

Our investigation has indicated that the development of NSR can also impact marine animals and seabirds as the significant influence on the retreat of sea ice reduces the active area of animals like sea birds or bears or some other species. The environment of the NSR is very vulnerable and should be protected more actively to prevent scenarios that endanger the ecosystem in the Arctic ocean. To develop the environment sustainably, we found that it is crucial to balance the environment and the economy of the NSR maritime freight transportation.

## 5.4 Social aspect of NSR maritime freight transportation

Our findings have revealed several outcomes of how the NSR maritime freight transportation has contributed to the social aspect of sustainability. Our empirical investigation has shown that the social improvements started with economic development impact on the local people and local economy. We found that freight transportation traffic on the NSR has grown dramatically in recent years, supporting socio-economic development in the Arctic region. Our findings are consistent with the study of Mani, Agarwal, et al. (2016) that social sustainability within the SCM can be linked to the goods and procedures evaluated to classify the socio-economic conditions of individuals in the supply chain.

We found that the development of maritime freight transportation via the NSR could provide certain benefits to people living in communities along the route, such as permanent or temporary job creation related to port construction and operations of natural resources projects and increased product availability. Based on the empirical findings, the Arctic inhabitants and NSR maritime activities are mutually dependent. As described in the empirical part (see Chapter 4.2), NSR is the only route to transport essential goods to remote indigenous people. Consistent with the current findings Sharma and Ruud (2003), viewing social sustainability as a necessity for human survival and future development.

Our research identified that the NSR freight transportation route creates connectivity with human life, particularly for native people. It provides many benefits, such as basic needs, medicine, and food. According to our findings, the NSR freight transportation addresses connectivity for people and businesses in the Arctic area. However, it is found that the development of freight transportation along the NSR route may have an additional impact on the vulnerability of Arctic communities as a result of changing environmental and social factors. We have identified that a lifestyle change primarily caused adverse effects on

indigenous communities on the living circumstances. The environmental threats caused by freight transportation development and global warming activities are also becoming among the key factors affecting the origin of indigenous populations of the Arctic origin. Our empirical findings are compatible with Seuring and Müller (2008) study on the social sustainability of environmental concern about the potential adverse effects of environmental pollution on human health, safety, and quality of life.

Our findings have shown that the NSR development brings many positive and negative impacts on the social aspects. The NSR maritime freight transportation sustainability should balance environmental, economic, and social aspects. If the NSR is developed with a specific focus on the economic aspect of sustainability, it simultaneously affects the environment and society, and vice versa. It is expected that the NSR development with a strong emphasis on sustainability can positively impact local people.

## 5.5 Container shipping as a sustainable solution for NSR freight transportation

Despite quite a long experience by Norilsk Nickel company in using containerships, our findings have revealed that containerships have recently become a prospective practice for international companies within the water area of the NSR. Our investigation has highlighted that containerships have a meaningful economic impact on the NSR and international trade despite several challenges in ice-infested waters. Containerships are one of the most cost-effective and environmentally practical transport types per unit. Our findings are consistent with the study of Bang et al. (2012) that high operational and financial efficiency standards that containers propose are what liner shipping firms look for to survive. One of the main drivers for greater supply chain integration is the increasing demand for the container transport system.

Our investigation has highlighted that containerships are also the most environmental, besides their economic benefits. Maritime freight transport in the NSR still is the most diminutive polluting mode of transport per ton of goods delivered over long distances. The increased demand for sustainable shipping along the NSR has prompted container shipping companies to improve their business processes and meet the environmental protection needs of shippers. Our empirical findings have revealed that container shipping has social benefits for the local people who live along the NSR. It contributes to providing local people in Arctic

hard-to-reach areas with fresh food, medicine, and other essential stuff to survive in harsh conditions. This finding is consistent with the study of Notteboom and Rodrigue (2008) that containerships are necessary for commerce and transport networks as a critical connection in the supply chain. Our research has found that container shipping on the NSR faces double obstacles because of competitiveness between many domestic and international shipping companies and their burden for sustainable performance. In light of this, shipping companies operating in the waters of the NSR proactively tackle their environmental and socio-economic obligations by developing SCM practices to resolve this problem.

In our master's thesis, we have identified that compared to other vessel types, containerships are a sustainable solution to develop NSR freight transportation because they contribute simultaneously to all three aspects of sustainability: economy, environment, and social. Our empirical findings are consistent with the study by Yang (2018) that balancing economic development and reducing the environmental effects of shipping operations has become highly important for container shipping companies. Our investigation has emphasized that container shipping can be viewed as one of the most important solutions for the sustainable development of NSR freight transportation.

# Chapter 6. Conclusion and implications

This chapter presents the master's thesis's implications for theory and practice. The chapter concludes with the limitations of this master's thesis and suggestions for further research.

## 6.1. Implications for theory

This master's thesis aims *to explore how sustainable development is shaped within the Northern Sea Route freight transportation*. The findings have revealed that the sustainable development of freight transportation along the NSR depends on the behaviors of numerous actors involved that are interrelated and affected by global and domestic regulations.

Our findings have revealed that the economic aspect is the primary driving force behind the development of freight transportation along the NSR, which is beneficial in many ways - e.g., shorter time delivery. Further, our investigation has shown that the environmental improvements reflected in implementing new vessel technologies and providing shorter distances across the NSR are expected to reduce global CO2 pollution. The findings have also identified that the development of NSR freight transportation is more favorable for the social aspect since the NSR is the only way to transport essential products, fresh food, medicine,... to the local people who live in highly remote areas. In contrast to previous research that focused on the economic and environmental aspects, our investigation highlights all three aspects of sustainability - economic, environmental, and social. Therefore, our empirical findings have illustrated how sustainable development has evolved and contributed to the development of NSR freight transportation. It appears that container shipping can be viewed as one of the most important solutions for the sustainable development of NSR freight transportation since container shipping is one of the freight transportation modes in the NSR that contribute simultaneously to all three aspects of sustainability.

This master's thesis, which is in line with current calls for conducting more case study-based research within the SCM field (Näslund, 2002; Seuring, 2005; Stock et al., 2010), explores freight transportation in real empirical settings, particularly within the water area of the NSR. Our investigation emphasizes the influence of the contextual settings on the development of freight transportation in a sustainable way, and all three aspects of sustainability should be taken into account.

## 6.2. Implications for practice

Practitioners that make decisions on adoption sustainability in the NSR freight transport development can take valuable insights from this master's thesis into consideration. This investigation can be helpful for decision-makers and policy-makers who are engaged in making global supply chains more sustainable. The findings of this master's thesis can help supply chain managers of international shipping companies which strive to develop their experience of sailing along the NSR and not hurt the sensible Arctic environment. Further, our findings can be helpful for managers of Russian industrial and shipping companies that have already used the NSR to make the delivery of their cargoes more sustainable.

Reflection on the historical development of the NSR freight transportation presented in this master's thesis can provide significant insights into implementing new sustainable supply chain strategies focusing on all three aspects of sustainability – economic, environmental and social. Managers may consider container shipping because of its benefits to more sustainable development for freight transportation in the NSR.

Increased awareness of the NSR freight transportation challenges and issues may help supply chain managers overcome the hurdles of moving to SSCM in other contexts. A proactive plan may eliminate or minimize barriers. Our findings may also be utilized in many industries to enhance their environmental sustainability and improve local living conditions.

## 6.3. Limitations and suggestions for future research

This master's thesis explores the sustainable development of freight transportation and container shipping in the particular empirical setting, the NSR. At the same time, other factors can affect freight transportation when developing it sustainably in other contextual settings. Future research may contribute to making freight transportation more sustainable through different aspects.

Our investigation has covered a limited number of respondents. Many interviews with various people involved in the development of freight transportation along the NSR can make it imperative to study more samples and respondents, specifically from different empirical contexts.

This master's thesis has not applied any specific theoretical lenses. As well-known in the literature, SSCM is affected by contextual and institutional factors. Therefore, it would be beneficial to explore freight transportation through institutional theory lenses that may provide promising theoretical insights to further research within the SCM field.

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# Appendixes

## Appendix A: Interview Guide

**General questions:**

1. What activities do you do with the center? What is your primary duty in the center?
2. How long have you been working there?
3. What kind of projects have been developed at the Center? Are new projects being developed, and in what direction?

**The development of NSR:**

4. How has NSR been developing recently?
5. What kind of cargo has been delivered recently along the NSR?
6. What type of vessel enters the NSR?
7. How has container transportation along the Northern Sea Route been developing in recent years?
8. Where is the traffic volume higher along the NSR?
9. Please, tell us about the development of transit shipping and domestic shipping. How are the dynamics of the development of cargo volumes distributed between transit shipping or domestic shipping?
10. Maersk distributed cargo for the first time in 2018 via NSR from Asia to Europe. Could you please comment on this first Maersk voyage? What kind of benefits did Maersk company gain?
11. What is the significance of such container transportation for the further development of the Northern Sea Route? Does Maersk continue to use the Northern Sea route after 2008? How many Maersk container vessels sail along the NSR?

12. What are the dynamics of the development of domestic shipping? Is there a difference between the western part and the eastern part of the NSR?

13. Is there an increase in container shipping domestically along the western part of NSR?

14. How is the regulation of navigation along the Northern Sea Route developing in recent years? Does the current law make it easier for international companies to enter the Northern Sea Route waters?

15. What are the advantages and outcomes of Arctic shipping?

16. Could you be so kind as to provide us with some materials about how NSR development influences international ports (Asian and European)?

**Sustainability:**

17. Can the development of the NSR become a worthy alternative to the Suez Canal?

18. What do you think about the capacity of the NSR and Suez Canal? Is there overcapacity of the Suez Canal?

19. What type of goods can make the NSR a worthy alternative?

20. Is it assumed that the NSR view mainly serves oil transportation? Does the NSR have the possibility to attract non-resources clients?

21. What kind of clients does the NSR attract now? What kind of clients can NSR attract in the future?

22. What kind of cargo can the NSR attract and transport now and in the future?

23. How long do the carriers have to wait for international transit?

24. How does the Russian government make the NSR more attractive for international clients as international trading goods? What is your opinion that the Russian government should do and change?

25. Since 2010, the regulation of sailing the NSR has changed dramatically. Has this change in the law of sailing via the NSR helped develop or increase cargo transport volume? What outcome of these changes?

26. How is the NSR suitable for oil transportation as domestic shipping? Is it assumed for international oil transportation? What are the opportunities here? What is the country that gains the benefit?

27. What do you think about the problem of empty voyages between Asia and Europe via the NSR?

28. Do shipping companies or shipowners pay insurance? Is this a required fee when going through NSR? Is there a way to reduce the amount of insurance for shipowners or companies?

29. What are the modern technologies achievement can make or already have made NSR more convenient for the clients?

30. What are the new developments that can help to protect and conserve the environment in the NSR?

31. Do you have any statistics about the oil spill or any other environmental problem via the NSR? Can you please provide us?

32. What do you think about the fact that an increase in cargo transportation means an increase in the number of ships, and the volume of fuel use will affect the vulnerable environment of the NSR?

33. What is the limit for greenhouse gas emission for the High North? For the vessel in the water of NSR?

34. What kind of infrastructure to avoid any emergency?

35. How does the NSR prepare for the collision or any emergency? Do you have any materials about these that you can give us? What happens in this case?

36. How does cargo transportation development via the NSR influence the development of the Northern port's infrastructure?

37. What type of cargo for domestic transportation?

38. How does the development of international transit affect the social aspect of people via the NSR?

39. What type of cargo in containers are transported via the NSR? How can these types of freight affect the social life of people in Asia and Europe?

40. What do you think the development of NSR can affect the local people's life? Can you please give us some materials related to the social aspect of the local people there?

# Appendix B: Example of permission to navigate in the water of NSR

Министерство транспорта Российской Федерации
Ministry of transport of the Russian Federation

Федеральное агентство морского и речного транспорта
Federal agency of maritime and river transport

Федеральное государственное бюджетное учреждение
Federal state budgetary institution

**Администрация Северного морского пути**
The Northern Sea Route Administration

**Р А З Р Е Ш Е Н И Е № 8 / 7**
PERMISSION

на плавание в акватории Северного морского пути судна
ледового класса Arc 7
for the ice class Arc 7 ship to navigate in the water area of the Northern Sea Route

Выдано: в соответствии с Правилами плавания в акватории Северного морского пути, 2020 г.,
The permission is issued according to the Rules of the navigation in the water area of the Northern Sea Route, 2020

на основании заявления от 27.01.2021 № б/н DYNAGAS LTD.
(заявитель)
based on the application dated January, 27 2021 № n/a DYNAGAS LTD.
(applicant)

| Название судна (Name of ship) | Номер ИМО (IMO number) | Флаг (Flag) | Ледовый класс (Ice class) | Валовая вместимость (Gross tonnage) |
|---|---|---|---|---|
| Fedor Litke | 9768370 | Кипр Cyprus | Arc 7 | 128 806 |

**Маршрут плавания (район работ):**
**Route of navigation (area of works):**

Западная/восточная граница СМП – порт Сабетта – восточная/западная граница СМП.
Western/eastern boundary of the NSR – port of Sabetta – eastern/western boundary of the NSR.

**Разрешено:**

– самостоятельное плавание **по чистой воде**, при **легком** и **среднем** типе ледовых условий во всей акватории Северного морского пути;

– самостоятельное плавание при **тяжелом** типе ледовых условий в районах **1-7**;

**It is permitted the following:**

– independent navigation in **ice free water**, in **light** and **medium** types of ice conditions in the whole water area of the Northern Sea Route;

– independent navigation in **heavy** type of ice conditions in the water areas **1-7**;

СВТ

– самостоятельное плавание при **тяжелом** типе ледовых условий в районах **8-28 с 01.07.2021 по 30.11.2021**;

– плавание под проводкой ледокола **по чистой воде**, при **легком, среднем** и **тяжелом** типе ледовых условий во всей акватории Северного морского пути.

– independent navigation in **heavy** type of ice conditions in the water areas **8-28 from 01.07.2021 to 30.11.2021**;

– navigation under an icebreaker assistance in **ice free water**, in **light**, **medium** and **heavy** types of ice conditions in the whole water area of the Northern Sea Route.

Тип ледовых условий (легкий, средний, тяжелый) на участках акватории СМП определяется по официальному прогнозу Росгидромета.
Type of ice conditions (light, medium, heavy) on the sea ways of the NSR water area are should be determined by the official forecast of Roshydromet.

Срок действия **РАЗРЕШЕНИЯ**: с 09.02.2021 (день, месяц, год) по 08.02.2022 (день, месяц, год)

**PERMISSION** is valid from 09.02.2021 (day, month, year) to 08.02.2022 (day, month, year)

И. о. руководителя Администрации
Северного морского пути
Acting head of the NSR Administration

(подпись)
(signature)

Н.А. Монько
N. Monko

г. Москва
Moscow

29.01.2021
(день, месяц, год)
(day, month, year)

# Appendix C: Example of refusal permit to navigate in the water of NSR

Министерство транспорта Российской Федерации
Ministry of transport of the Russian federation

Федеральное агентство морского и речного транспорта
Federal agency of maritime and river transport

Федеральное государственное бюджетное учреждение
Federal state budgetary institution

**Администрация Северного морского пути**
The Northern Sea Route Administration

**У В Е Д О М Л Е Н И Е № 15**
**NOTIFICATION**

об отказе в выдаче разрешения на плавание судна
в акватории Северного морского пути
of refusal to obtain the permission to navigate in the water area of the Northern Sea Route

Выдано: в соответствии с Правилами плавания в акватории Северного морского пути, 2013 г.,
The notification issued in accordance with the Rules of navigation in the water area of the Northern Sea Route, 2013
по результатам рассмотрения заявления от 10.09.2020 № б/н
by the results of consideration of the application from September, 10 2020 № n/a

Cosco Shipping Specialized Carriers Co. LTD
(заявитель)
(the declarant)

| **Название судна (Name of ship)** | **Номер ИМО (IMO number)** | **Флаг (Flag)** | **Ледовый класс (Ice class)** | **Валовая вместимость (Gross tonnage)** |
|---|---|---|---|---|
| Zhi Yuan Kou | 9639452 | Китай China | Ice 1 | 32 793 |

Судну отказано в выдаче разрешения по следующим основаниям:
The ship is refused to obtain the permission to navigate in the water area of the Northern Sea Route due to:

**Отсутствует копия Перечня оборудования для Свидетельства судна полярного плавания.**
Copy of the Record of Equipment for the Polar Ship Certificate didn`t provided.

И. о. руководителя Администрации
Северного морского пути
Acting Head of the NSR Administration

Н.А. Монько
N. Monko

(подпись)
(signature)

г. Москва
Moscow

14.09.2020
(день, месяц, год)
(day, month, year)