Potential Financial and Environmental Outcomes of the Northern Sea Route

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This bachelor's thesis focuses on providing an overview of the current state of logistics in the Northern Sea Route and analyzing its commercial viability in the future. In addition, it explores the potential environmental and sustainability risks that the Arctic region might face due to increased shipping activity in the area. The study was begun with a theoretical framework that draws upon peer-reviewed, high-quality academic literature to establish relevant theories, concepts, reports, and models.

To guide the research, four investigative questions were formulated. Each investigative question focused on a specific goal: review the current state of the Northern Sea Route, explore its potential financial benefits, reveal its environmental risks, and reflect on the findings in the scope of the Nordic countries. This demarcation allowed the author to concentrate on the critical topics and discussion points, including evaluating supply chain risks, exploring the international aspect of the Northern Sea Route, and predicting future cargo vessel deployment on it.

Qualitative research for this thesis involved conducting three interviews with logistics managers and experts, focusing on the feasibility of the North Sea Route supply chain. Combined with theory-based investigation, this approach allowed for a more in-depth exploration and elaboration of the research question and overall topic.

The findings indicate that, while highly lucrative due to its time and distance-saving benefits, the Northern Sea Route cannot compete with conventional sea trading corridors. However, the research suggests that there is still considerable potential for developing safe and predictable shipping through further research and investment. Creating a mixed model of Asia-Europe logistics for high-value and urgent cargo is a promising area to explore.

In conclusion, this thesis highlights the need for further research and development to ensure the safe and sustainable expansion of shipping activity in the Arctic region. It provides a framework for understanding the complexities and challenges associated with the Northern Sea Route and lays the groundwork for future investigations.

Key words
Northern Sea Route, container shipping, Asia-Europe corridor, environmental costs, sustainability

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1 Introduction

This paper is a research type of a bachelor's thesis for the Degree Programme in International Business in the major specialization of Supply Chain Management at the Haaga-Helia University of Applied Sciences. The topic of this thesis is the potential financial benefits and environmental outcomes of the Northern Sea Route and the current barriers to fully utilizing it for the Asia-Europe supply chain.

This chapter provides the topic's background, research question, investigative questions, and general demarcation. It also discusses the potential benefits and risks for the parties involved in the research. This section introduces key concepts and theories essential for the reader's understanding of the paper.

The chapter concludes with a detailed introduction of the commissioning company and the reasons for their interest in this research. Understanding the commissioning company's perspective adds depth and relevance to the study and provides a foundation for exploring the potential practical implications of the findings.

1.1 Background to the topic

For decades, Asia and Europe have been trading back and forth using a variety of routes, from the Silk Road in the past to the most recent technological advancements that allowed for the utilization of bulk carriers and air transportation. While a few decades ago, it seemed like the routes were fully optimized, and no new ones appeared to be available for commercial transportation, the supply chain industry is on the verge of entering a new chapter in its history – Arctic shipping.

Thanks to human industrial activity, the Arctic ice mass is rapidly decreasing, unveiling new possibilities for shipping between these two continents. In this thesis, the author explores the potential benefits and barriers of this promising new route, which has already gained traction due to the rising costs of traditional shipping methods and the recent blockage of the Suez Canal. Moreover, with the emergence of Japan, China, and South Korea as Arctic maritime nations, the Arctic shipping route is poised to significantly transform the global logistics landscape (Humpert 2011).

The growing demand for shipping between Asia and Europe is reflected in the rising trend of containership traffic from Asia to Europe. In 2021, approximately 40% of containerized goods were transported along the East-West route, according to UNCTAD (2022, 9). However, this trend could lead to congestion and overcapacity on conventional trading routes, particularly the Suez Canal. This vital trade artery saw its cargo volume more than double between 2000 and 2014, from 368

million tons to 822 million tons (Zhao & al. 2016, 50). As a result, discussions about alternative shipping corridors have gained significant traction in recent years, with the Northern Sea Route being touted as the most promising substitute.

As reported by The Arctic Institute, over the past decade, Asia has significantly overtaken North America in terms of exports to Europe, a trend that is highly likely to continue in the future (Humpert 2011). Establishing the Northern Sea Route could reduce shipping time by 10 to 15 days, as reported by The Guardian in 2021. This could enable more precise demand and supply planning for receivers of goods, as well as more proactive decision-making during times of uncertainty.

However, this developing project does come with a major trade-off, one that, in today's world, becomes pivotal. The impact on the polar environment is a major concern for international experts when discussing the increase in the usage of Arctic shipping. Oil and gas transportation poses huge risks to this pristine region, the results of which might very well be irreversible. This paints a concerning picture that suggests establishing international regulations and jurisdiction prior to the actual launch of the shipping route that could guarantee the long-term preservation of the polar region (Yanes 2021).

1.2 Research question

This thesis aims to provide a comprehensive analysis of the potential environmental and financial impacts of utilizing the Northern Sea Route for commercial logistics. The findings of this study are crucial for supply chain managers of companies operating within the Asia-Europe supply chain, as well as business professionals who aspire to build more sustainable businesses and operations. The insights generated by this thesis can guide decision-makers in developing a more holistic and responsible approach to logistics that takes into account both economic and environmental considerations.

The international aspect required by the degree programme for all theses is covered by investigating the supply chain that potentially includes a range of countries. The list of counties includes but is not limited to the EU states and East Asian states like China, Japan, and South Korea. The international aspect is also covered by the thesis author, who is a Russian student gathering data in the English language for a Finnish commissioning company.

The research question (RQ) of this thesis was "**What are the potential environmental and financial outcomes of utilizing the Arctic shipping route for commercial cargo transportation?**". The research question was divided into investigative questions (IQ) as follows:

IQ 1. What is currently preventing the Northern Sea Route from being fully available for commercial cargo transit, and when will it be fully accessible?

IQ 2. What financial benefits can the Northern Sea Route potentially bring for companies that require sea transportation from/to Pacific Asia/Europe?

IQ 3. To what extent is the potential Northern Sea Route detrimental to the environment, specifically marine sustainability?

IQ 4. How likely are Nordic companies to start utilizing the Northern Sea Route, and what parties will it involve in the process?

Table 1 presents an overlay matrix of this thesis. The aim of the overlay matrix is to give an overview of the thesis, its targets, the methods that the author is going to use to achieve them, and the anticipated result.

Table 1: Overlay matrix

Investigative questions (IQ)	Theoretical Framework	Research Methods	Outcomes
IQ 1.	• Container shipping industry • Transit time and distances • Supply chain networks and infrastructure	• Academic literature review • Qualitative interviews	Evaluation of the current state of the Northern Sea Route and its viability in the present day
IQ 2.	• Supply chain management • Logistics risk and cost management • Supply chain networks and infrastructure	• Academic literature review • Qualitative interviews	Financial overview of the potential benefits and theoretical comparison model with the conventional trading route
IQ 3.	• Sustainable supply chain • Supply chain risk mitigation • Environmaental risks	• Academic literature review	Insigths on the preventive measures and mitigating techniques of the detrimental effect of the route
IQ 4.	• Supply chain development • Container shipping industry	• Academic literature review • Qualitative interviews	Supply chain expert reflections and suggestions and theoretical perspective from the Nordic logistics perspective

1.3 Demarcation

In this subchapter, the demarcation of this research thesis will be thoroughly discussed, and the main focus areas will be highlighted. By doing so, the author and the reader can stay focused on the relevant questions and topics without wasting time and resources on irrelevant matters. This

thesis is centered on the Supply Chain Management of business administration and the processes involved in it, with transportation and logistics being the main processes. Additionally, the research will investigate sustainable business practices and their environmental impact.

To further define the scope of the research, one of the demarcation points is the relationship between the parties in the supply chain. Specifically, the focus of the research is on business-to-business commercial logistics, enabling the shift towards corporate culture and corporate benefits in terms of finances.

As stated in the topic name, the geographical demarcation of the given research narrows down the pool of countries involved to those that are part of Europe, the EU specifically, and the Pacific part of the Asian continent.

Given the projected timeline derived from the preliminary research, the Arctic transportation route is a topic of the 2050s. This marks another demarcation point in a time-wise manner. What it also allows to achieve is to focus on two stages: preparation prior to the utilization of the route and the actual implementation of it.

As for the legislation demarcation, it is vital to mention that given the geographical scope of the research, the focus should be on European Union laws and maritime legislation. However, it may also include international law in some instances, considering that the intended supply chain would cover a range of countries.

In terms of cargo transportation, this thesis focuses primarily on the containership industry, which is the most effective means of transport for the commissioning company's goods. The reasons for this preference will be elaborated in the introduction chapter of the commissioning company.

It's important to note that the geographic region under discussion is one that has already been heavily politicized and will continue to be so in the future. The author recognizes that geopolitical issues are a complex matter best left to political science students and experts. As a result, the focus of this thesis is solely on the potential business opportunities in the Arctic region, with any potential political disputes mentioned only briefly as a possible threat to the region's economic development.

These are the main demarcation criteria set for the research. Their goal is to clearly define the focus of the work and state what one can expect from this research-based thesis. Table 2 presents a compact overview of the aforementioned demarcation points.

Table 2: Thesis demarcation

Demarcation point	**In scope of the research**	**Out of scope of the research**
Geographical group	EU countries, especially the Nordics, East Asian countries, especially China, and Russia	Countries outside of the Northern Sea Route
Customer group	Business-to-Business	Customer-to-Customer, Business-to-Customer, Customer-to-Business
Parts of the Supply Chain	Transportation and logistics	Any other parts and/or stages of the Supply Chain
Timeline	Present day and foreseeable future, mid 21st century specifically	Past events and supply chain of processes older than 20 years
Legislation	EU, International and Russian directives and policies	Legislation of the countries outside of the Northern Sea Route
Cargo type	Containers and means of their transportation	Mineral resources, tourist, food, and any other logistics
Geopolitical	Only touched upon as a potential threat for supply chain development	Speculation and discussion involving political expertise

1.4 Commissioning company introduction

The case company for this research-based thesis is Kuori Oy.

Kuori Oy, a Finnish company headquartered in Espoo, specializes in providing custom display and touchscreen solutions for various industries, including outdoor sports, entertainment, advertising, and catering. Established in 2017, the company has shown significant growth in recent years, with a turnover of 6.7 million euros in 2021, and is included in Kauppalehti's 2022 "Kasvajat." With a current workforce of 43 employees, Kuori Oy is looking to explore alternative shipping methods for its supply chain, particularly the Northern Sea Route, to increase the efficiency of its product transportation from China to Finland in the future.

This research-based thesis aims to provide the commissioning company with a comprehensive outline and the potential benefits of using the Northern Sea Route. It is of great interest to Kuori Oy as it seeks to optimize its operations and streamline its supply chain.

1.5 Benefits

The primary objective of this thesis is to conduct a comprehensive study on the feasibility of the Northern Sea Route as a viable option for companies engaged in Asia-to-Europe logistics, with Kuori Oy as the commissioning company. The research focuses on the financial aspects of using the Arctic shipping route as a potential alternative to traditional transportation modes, such as the Suez Canal. Additionally, this thesis aims to evaluate the environmental risks of using this route and its impact on the sustainability of the Arctic region. By analyzing both financial and environmental factors, the research seeks to provide insights that can assist Kuori Oy in making informed decisions about its supply chain operations.

The benefits for the commissioning company extend beyond just long-term knowledge. By gaining a deeper understanding of the potential benefits and risks associated with the Northern Sea Route, Kuori Oy can make informed decisions regarding its supply chain operations in the future. This can result in significant cost savings, improved efficiency, and a competitive advantage in the marketplace.

Furthermore, the research conducted in this thesis can also benefit other businesses operating in the Nordics and beyond. By sharing the findings of this research publicly, companies can better understand the potential benefits and challenges of utilizing the Northern Sea Route for their supply chain operations. This can contribute to the growth and development of sustainable and efficient logistics practices on a global scale.

Finally, the research can also benefit individual supply chain professionals, both current and upcoming, the author included. By providing insights into the technicalities of transit through the Arctic region, this thesis can equip professionals with the knowledge and confidence to navigate the new stage of intercontinental logistics. Additionally, the research can serve as a foundation for future studies and advancements in sustainable logistics practices.

1.6 Key concepts

The Northern Sea Route (NSR) can be defined as a sailing corridor for vessels going from Asia to Europe. It is important to notice that since Russia plays a major part in the development of NSR, it is often referred to as “Severnyy morskoy put” by Russian researchers (Didenko and Cherenkov 2018, 1-2).

Supply chain management involves the coordination and planning of sourcing, procurement, conversion, and logistics management activities. This includes working with suppliers,

intermediaries, third-party service providers, and customers to integrate supply and demand management across companies (CSCMP 2013).

Transport logistics "**…**involves the movement of goods through the supply chain, but is more than just the freight transport aspect and embraces the full commercial and operational frameworks within which the movement of goods is planned, managed and finally carried out" (Button 2010, 528)

Container shipping is an economic concept that refers to distributing goods via a unisized form (a container) and allows for an intermodal system of transport (Branch 1988, 79).

"**Sustainability** is the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs." It involves finding a balance between economic, social, and environmental factors and ensuring that the resources and systems we rely on can be maintained in the long term, according to the UN (Brundtland 1987).

2 The Northern Sea Route – current state, barriers, and threats

This chapter introduces the main topic of the thesis, the Northern Sea Route (thereafter the NSR), as well as the main concepts and models around it.

2.1 The NSR introduction and overview

The NSR is a passage along the Russian Arctic coast, connecting the Atlantic and Pacific Oceans and providing access to ports in Europe and Asia. This shipping lane is considered an alternative route that can shorten transportation time and costs between Asia and Europe compared to the traditional Suez Canal shipping routes. However, the route is subject to seasonal ice cover, which limits its navigability and poses significant challenges and potential risks to ship navigation. These topics are covered in the following subchapters of the thesis. Figure 1 presents the geographical overview of the NSR compared to the conventional Suez Canal route.

Figure 1. Geographical overview of the NSR and the Suez Canal route (Zhao et al. 2016, 51)

2.1.1 A brief history of the NSR

The Arctic region where the NSR lies first began to be explored as early as the 16th century, although it was not until the 1930s that occasional transits started to take place on the route. During the second world war, a convoy of American ships transported lend-lease goods from the

Pacific to the west side of the NSR. During the Soviet times, first, the year-round route was initiated between Dudinka on the Yenisey River and Murmansk, transporting metals and ore from Norilsk.2 Transit sailings were rare, but they did take place. In the mid-1980s, several voyages took grain from Canada to Murmansk and gas pipes from Japan to West Siberia.

Traffic on the NSR peaked in 1987 with a total freight volume of about seven million tons. It fell rapidly afterwards due to reduced economic activity in the north, connected to the abolition of the centrally planned economy. With the transformation of the financial system and continued economic recession, financing of NSR infrastructure became a big challenge, and ports and navigational systems deteriorated. Traffic continued to decline. The Northern Sea Route Administration was dissolved in 1999 (Moe 2014, 785).

The revitalization of the NSR as an international transit transport corridor began in 2009. For Russia, modernizing and converting the NSR into a reliable and economically efficient transportation corridor was deemed a crucial task in building integral social and economic infrastructure to unlock the vast potential of Siberia for future development. The mega-grid of this infrastructure could be formed by Siberian rivers that cross the country's space between the economically developed belt in the south (formed along the Trans-Siberian Railway) and the Russian Arctic regions (Didenko & Cherenkov 2018, 3).

Examples of successful commercial voyages along the NSR include a Danish-flagged ship completing a trial voyage from Vladivostok to Saint Petersburg. During the 37-day voyage, the ship remained in regular dialogue with Russian authorities and Ice-breaker companies, as reported by The Guardian (2021). Earlier before, in 2013, a Chinese Young Sheng containership also successfully transited along the NSR carrying containerized tools and heavy equipment from China to the Netherlands (Raspotnik and Stephen 2013). The remarkable thing about this voyage was that it was the first time a Chinese-flagged cargo vessel was transporting goods on the NSR.

2.1.2 Ice condition on the NSR

Due to its geographical location, the NSR is a route that is hugely affected by natural barriers, namely icebergs. However, the trends have shown that due to overall planet climate change, the region can be found ice-free already in the 21st century. Since 1979, there has been an observed trend of decreasing late-summer sea ice extent in the Arctic through satellite mapping. The statistics show that the six lowest years on record have occurred since 2006. Climate model forecasts suggest that this trend will persist and that the Arctic Ocean will be seasonally ice-free later in this century (Smith & Stephenson 2013). As a result of these observations, the researchers

in the field have established several prediction models to assess and forecast the future shipping activity in the Arctic.

The model proposed by Smith and Stephenson (2013) used the Arctic Transportation Accessibility Model and predicted that by the midcentury (2040-2059), the potential for navigation in the region would increase significantly overall. In terms of the probability of the NSR voyages, it was indicated that it could rise up to 94-98% as opposed to just 40% during the years before 2005. Additionally, it was found that the overall frequency and geography of the voyages could be increased, with the route shifting to the north of the Russian coastline. Figure 2 presents the overall view that the model predicted. The blue lines represent Open Water class vessels, while the red indicate the ice-strengthened ships (class PC6).

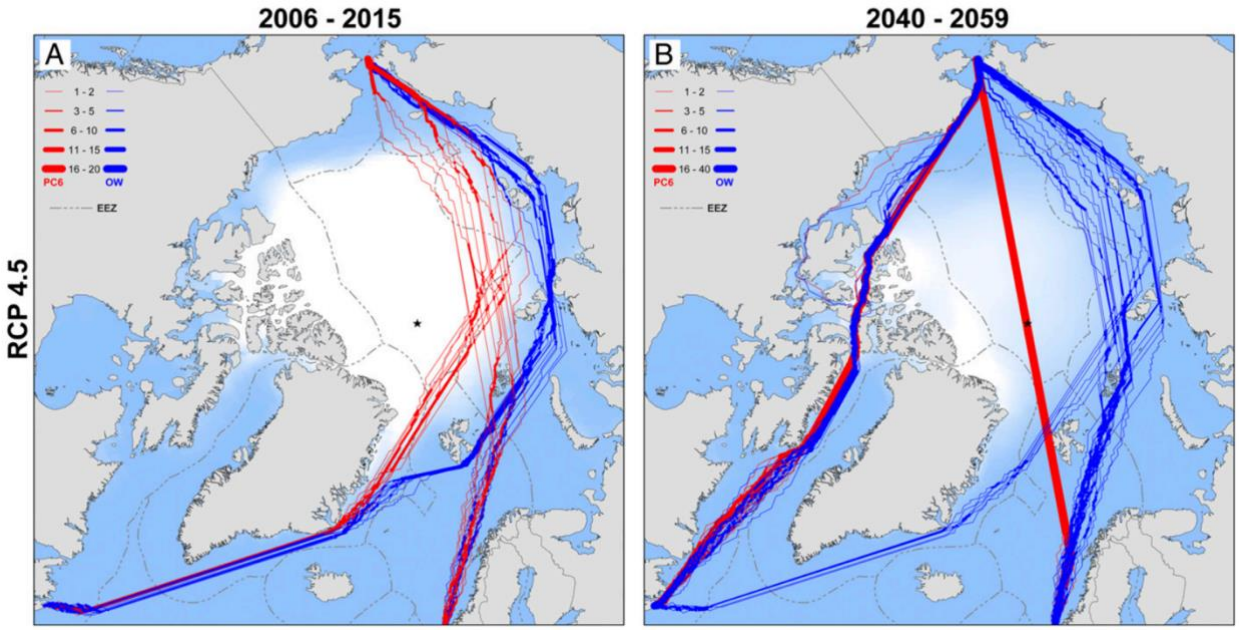

Figure 2. Optimal September navigation routes for hypothetical ships crossing the Arctic (Smith & Stephenson 2013)

However, it should be noted that as climate models often trail behind the current satellite observations of declining Arctic Sea ice cover, it is possible that they are conservative in their projections.

This model is backed up by research conducted by Copenhagen Business School's Maritime Division, whose model projected that the Arctic shipping route along Russia's northern coast may become competitive for some ships of comparable size only after the year 2035. The study conducted by CBS utilized a unique calculation methodology to assess the feasibility of investing in ice-reinforced vessels for operations on the NSR. The tool, which takes into account over a dozen

factors such as vessel specifications, engine type and capacity, transit fees, navigation season, and load factors, calculates the comparative costs per container against those of an ordinary container ship sailing through the Suez Canal Route. The authors of the study state that the tool combines an economic framework with applied naval engineering and is the first of its kind to specifically compare Arctic shipping with traditional routes (Humpert & Raspotnik 2016).

Finally, the studies seem to concur that despite the climate policies being introduced to preserve the Arctic region, the navigation season along the NSR will continue to grow during the 21st century, opening access to more navigable and predicted shipping. Figure 3 shows the prediction by Hassol (2004).

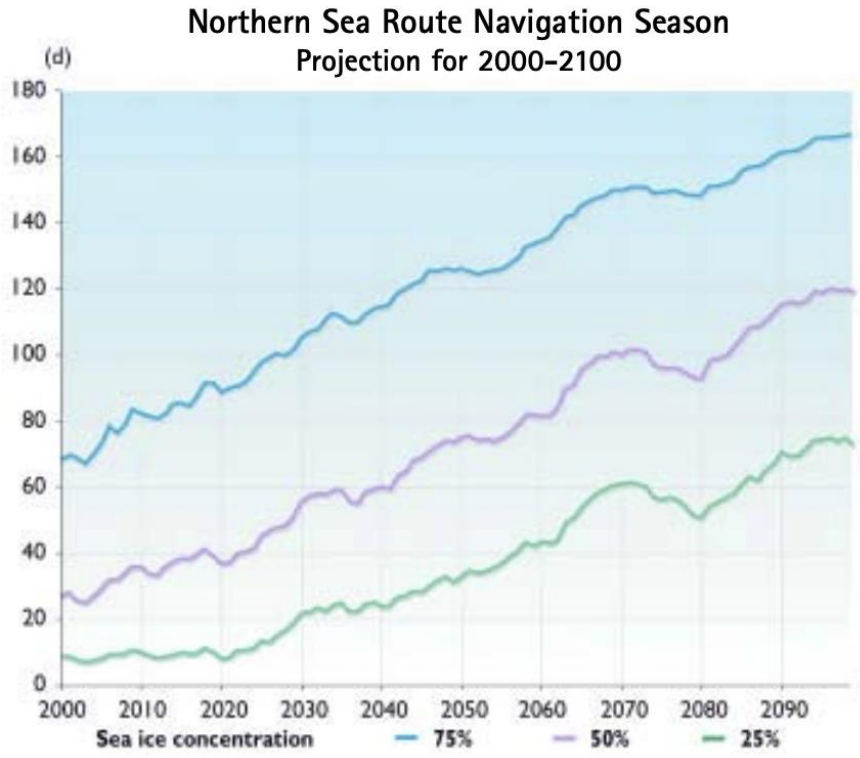

Figure 3. Projected increase in days (Hassol 2004, 83)

2.1.3 Comparison of the NSR with conventional shipping routes

As mentioned previously, the concept behind the development of the NSR is to provide shorter distances for voyages, resulting in significant time savings during transit. This advantage is expected to be increasingly necessary for the shipping industry as congestion on traditional trading routes is anticipated to grow.

The primary trade route for container traffic between Asia and Europe is currently the Suez Canal, with container vessels accounting for 34% of vessels passing through it in 2015. However, the continuous growth of traffic puts pressure on the canal to avoid congestion and disruption, leading to the need for adaptation. As container movements are expected to increase further, and the southern route has limited capacity, there is a need to explore other alternative trade routes (Solvang, Karamperidis, Valantasis-Kanellos & Song 2018, 497).

The following table present an overview that compares the NSR and the Suez Canal routes for ships traveling between Europe and Asia.

Table 3: Transit time and distances comparison between the NSR and the Suez Canal route (adapted from Didenko & Cherenkov 2018, 2 and Wergeland 2010)

	To Hamburg from:	
Shipping routes	⇩	⇩
Destination	Yokohama	Shanghai
The NSR (nautical miles)	6920-7200	8234
The Suez Canal route (nautical miles)	11430	10857
Total voyage days at service speed via the Suez Canal route	34	20
Total voyage days at service speed via the NSR	23	18

It should be pointed out, however, that these results are highly speculative due to the subjective speed, size, and fuel consumption of the vessel as well as the weather conditions. The model suggested by Wergeland (2010) selected a Chinese 4000 TEU container vessel that travels at a speed of 23 knots via the Suez Canal route and 14 knots via the NSR. The other models presented in this thesis looked at different speeds and fuel consumption rates; thus, the numerical results might differ slightly.

From a purely geographical perspective, it is clear that the NSR presents itself as a viable alternative to the Suez Canal route. The NSR offers substantial reductions in transit time, which can prove to be crucial in terms of efficiency and competitiveness.

2.1.4 The NSR administration, network, and legislation

Due to its location, the NSR is predominantly situated within Russian waters, which subjects it to Russian legislation and administration. The Russian government plays a significant role in managing and regulating activities along the NSR, including navigation, permits, and infrastructure development. This close association with Russian jurisdiction has implications for the operations and governance of the NSR as an international shipping route.

This subchapter aims to provide an overview of the key administrative aspects related to the NSR. As a major shipping route situated within Russian waters, the NSR is subject to various administrative regulations and policies. The chapter will discuss the role of the Russian government in managing and overseeing NSR operations, including the establishment of the Northern Sea Route Administration. Additionally, it will explore the permit system for vessels navigating the NSR, addressing the requirements and procedures involved. The subchapter will also touch upon infrastructure development and maintenance along the NSR, highlighting the efforts taken by the Russian authorities to enhance its navigability and safety.

The NSR is managed and operated by authorized shipping companies acting as Marine Operations Headquarters (MOHQs). These MOHQs are responsible for various operational aspects along the NSR, including scheduling, route assignment, navigational support, and pilotage. It is worth noting that entrusting private shipping companies with the navigation of the NSR may seem unconventional, considering the potential conflicts among various stakeholders involved in this sensitive route.

Private companies naturally prioritize cost and revenue from a business or user perspective, which may not always prioritize the overall socioeconomic effects of NSR utilization when making decisions. However, these authorized shipping companies have been assigned specific areas of authority divided at longitude 125E in the Laptev Sea.

For ships originating from the western end of the NSR, the MOHQ located at Dikson on the Kara Sea coast is responsible. The Dikson MOHQ is operated by the formerly state-owned Murmansk Shipping Company (MSC). Prior contractual arrangements must be made with MSC's administrative offices in Murmansk for ships entering the route in this direction.

For traffic originating from the eastern end of the NSR, the corresponding authority is the Far Eastern Shipping Company (FESCO). FESCO's administrative office and the MOHQ are located in Vladivostok and the East Siberian Sea port of Pevek, respectively. These arrangements ensure that both ends of the NSR are effectively managed and coordinated by the authorized shipping companies in their respective areas of authority (Liu & Kronbak 2010, 436-437)

Figure 4. The NSR administration map, responsibility areas, and shipping activity (CHNL 2017)

In March 2013, the Northern Sea Route Administration introduced a new administrative structure, which aimed to streamline the process of handling vessels using the route. One notable change was the implementation of an electronic application system, where a minimum notice of 15 days was required for vessel applications, replacing the previous requirement of a 4-month notice. These administrative improvements were intended to enhance the efficiency, attractiveness, and competitiveness of the NSR.

However, it is important to note that the NSR still lags behind the Suez Canal in terms of administrative efficiency. The Suez Canal operates on a four-day notice basis, allowing for even quicker processing and transit arrangements for vessels. While the NSR has made progress in simplifying administrative procedures, it still has room for further improvement to match the level of efficiency seen in the Suez Canal (Solvang & al. 2015, 498).

As for Russia’s plans for the development of the NSR, they seem quite ambitious. To support the infrastructure of the route, the government allocated its funds to development projects in the Arctic region. The construction traffic associated with the development of the port of Sabetta and the

Yamal liquefaction plant has played a significant role in the increased traffic along the Northern Sea Route in recent years. These infrastructure projects have attracted a large number of vessels transporting materials and equipment to support construction activities.

In 2017, the port of Sabetta witnessed a substantial increase in vessel calls, with nearly 300 vessels visiting the port. This made Sabetta the most frequented port along the route by a significant margin. In comparison, Mys Kamennyy, another port along the Northern Sea Route, had 178 vessel calls during the same period.

The growth in traffic at the port of Sabetta highlights its importance as a key hub for transportation and logistics in the region. The construction activities associated with the port and the Yamal liquefaction plant have contributed to the overall development and utilization of the Northern Sea Route as a viable transportation corridor (Humpert 2017).

During a recent cabinet meeting, the Russian government approved a budget of approximately $60 million for new developments along the NSR. A significant portion of these funds will be allocated to the establishment of an advanced ice monitoring system. This system aims to provide real-time information on ice conditions to vessels operating on the NSR, enhancing safety and efficiency.

In addition to the ice monitoring system, Russian energy company Rosneft has ambitious plans for the construction of one of the world's largest oil-loading terminals at the head of the bay along the NSR. This terminal is projected to handle the shipping of up to 100 million tons of petroleum products by the year 2030. In its initial phase, the port will feature five berths extending along a 1.3-kilometer-long dock. The scale and significance of this project make it the largest oil development in at least a decade.

These new developments and investments highlight the growing importance and potential of the NSR for trade and energy transportation, as well as the commitment of the Russian government and key companies to its development and utilization (Humpert 2023).

This serves as concrete evidence that the growth and expansion of Russia's resource infrastructure along the NSR continue to be the primary driver for shipping activities in the region.

Despite its potential, the NSR still faces obstacles in fully integrating into the global shipping market. The existing infrastructure along the route is limited and may struggle to meet the requirements of the modern shipping industry. Among the 18 ports in the Russian Arctic, the notable ones include Murmansk, Arkhangelsk, Sabetta, and Dudinka. However, it is worth mentioning that only Murmansk, Arkhangelsk, Vitino, Sabetta, and Pevek are currently operational for international transportation (Milaković & al. 2018, 56)

In terms of the international potential of the NSR, Moe (2014, 786) argues that “its use should be subject to international agreements.” Currently, the main legislation and policies that apply to the NSR are the International Code for ships operating in Polar Waters as well as the Polar Code. The former entered into force in 2017; therefore, the Arctic waters started to receive more international attention. The latter, however, is a focal point in the regulatory architecture of polar shipping. It is comprehensive, target-driven, and risk-focused. It operates on the principle that the existing safety and environmental regulations are applicable to polar shipping, with the Code imposing additional requirements. The regulations are aimed at achieving specific goals, emphasizing that ship owners should not only meet a standard or rule but also deliver the desired safety and environmental protection outcomes. It includes two parts with mandatory rules and recommendations (Chircop 2016, 46).

Further governance of Arctic shipping is accompanied by the Arctic Council (established in 1996). While it is not a regulatory body, it does help notably to facilitate the cooperation between the parties involved in Arctic shipping.

While it may seem that these policies and legislation should be sufficient to enable secure and sustainable shipping in the Arctic, Chicorp (2016, 49) thinks that the content will be subject to “adaptive learning” through a series of negotiations and compromises. He also points out that the current legislation has a rather narrow environmental scope, something that is vital for ensuring the preservation of marine sustainability in the region.

All in all, it can be argued that at present, despite the efforts of the Russian government to position the NSR as a viable alternative to the Suez Canal route, there are still foundational elements that need to be addressed. The legislation pertaining to NSR shipping requires further development and discussion, and the reliance on private company-based regulation raises concerns and hesitance among international shippers.

2.1.5 Shipping statistics on the NSR

In this subchapter, the latest statistics on voyages along the NSR are presented. It is important to note that the statistical data includes a variety of voyages, encompassing fishing, tourism, liquefied natural gas, mineral ore, and containers. While container cargo is the most relevant type for this thesis, it is necessary to include other types of freight to provide a comprehensive overview of NSR shipping patterns.

Gunnarsson and Moe (2021, 7) tried to differentiate the two types of voyages that took place on the NSR in 2010-2019. A transit of the ship that takes place between two non-Russian ports and

happens along the NSR is regarded as an “International transit voyage.” “Destination voyage,” however, refers to shipping between a Russian and a non-Russian port. The results of their research can be found in Table 4.

Table 4: International transit voyages and destination voyages on the NSR during the period of 2010-2019 (adapted from Gunnarsson & Moe 2021)

Year	International transit voyage	Tons of cargo transported	Destination voyage	Tons of cargo transported
2010	1	41,000	1	70,165
2011	4	185,243	14	590,102
2012	9	337,371	17	793,315
2013	14	633,791	14	484,097
2014	4	72,472	2	0
2015	6	34,938	1	0
2016	8	201,946	5	0
2017	12	154,415	4	20,253
2018	17	339,070	2	144,499
2019	14	285,245	8	361,094

The majority of the vessel types that transited on the NSR during the given time period were tankers, bulkers, LNG carriers, and general cargo vessels. The significant decline from 2014 to 2016 is mostly explained by the Ukrainian crisis and increased military activity, which jeopardized the trustworthiness of business partnerships with Russia. However, in absolute terms, the number of transiting vessels remained very low, with sailings limited to only 4-5 months during the summer-autumn season. Despite the efforts of Atomflot, and the promotion of international shipping on the NSR, shipping companies, and cargo owners showed limited enthusiasm or interest.

As for the total statistics, which includes shipping between two Russian ports, Humpert (2017) reported that in 2017, shipping traffic along the Northern Sea Route in Russia's Arctic waters

experienced significant growth. The cargo volume on the route is expected to increase by nearly 40 percent compared to the previous year, 2016. This year he also highlighted that in 2022, Russia's Arctic shipping lane exceeded the official target of 32 million tons by 2 million tons. This indicates a modest increase of 966,000 tons compared to the previous year, 2021. He also highlighted that during the peak season, 94 vessels could be found on the NSR at the same time. Figure 5 depicts the fluctuation of the number of vessels on the NSR in 2022.

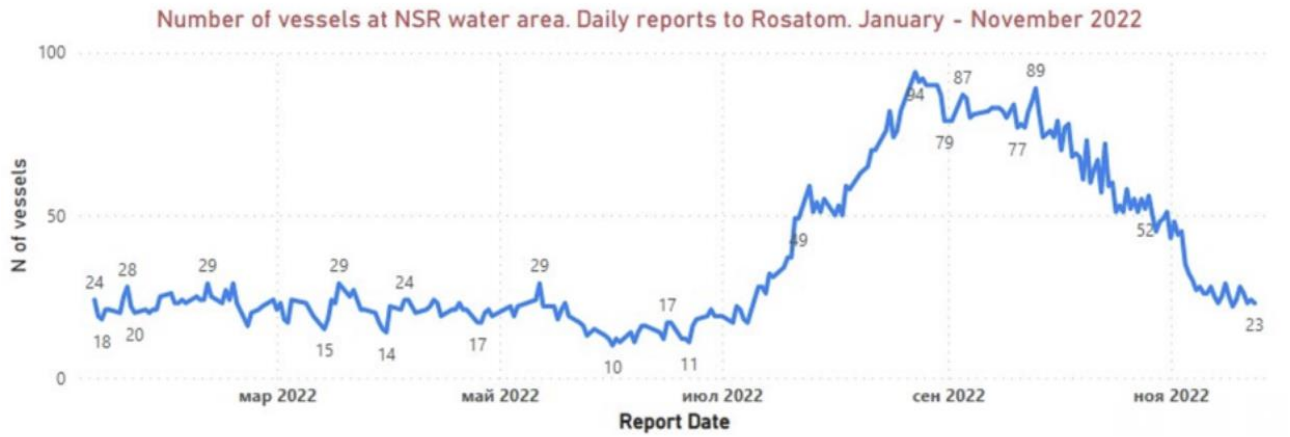

Figure 5. Number of vessels on the NSR in 2022 (Humpert 2023)

Russia’s ambitious plans aim for 80 million tons of cargo transported on the NSR in 2024, although given the current circumstances, this target seems unlikely to be achieved. The most optimistic forecast states that 92 million tons could be achieved, where 44% of the freight would be natural gas (Eliseev & Naumova 2020, 160).

When it comes to port calls, which are crucial for a well-developed marine supply chain, they also can only be forecast. These predictions heavily depend on the completion of Russia’s current Arctic projects. Atomflot estimates that once the project in Sabetta is fully developed, there will be approximately 200-250 port calls annually by LNG carriers (Moe 2014, 792).

This raises a question of what the prospects of container shipping on the NSR are. As can be seen from Figure 6, the container industry is yet to fully enter its Arctic stage of development. Gunnarsson and Moe (2021, 22) also argue that the aforementioned Danish-flagged containership was more to do with simply repositioning the vessel from Asia to Europe rather than fully exploring the option of Arctic shipping. This is because, however many investments Russia makes into the NSR, it cannot determine the international traffic alone despite positive growth in containership traffic between Asia and Europe.

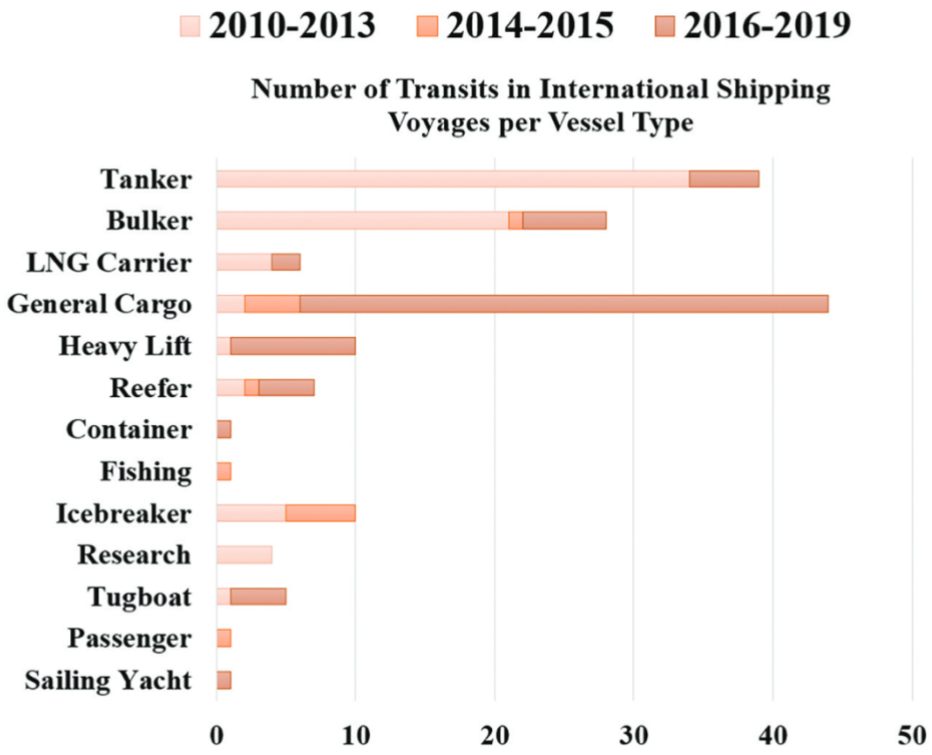

Figure 6. International transit voyages by vessel types 2010-2019 (Gunnarsson & Moe 2021, 12)

Danilov (2021) reported that The Russian Northern Sea Route Administration had issued 1,155 permits for navigation along the NSR, which represents an increase of over 18 percent compared to the number of permits issued for the same period last year. However, the majority of these permits were for internal Russian carriers that facilitate the development of Arctic projects and the internal economy. Therefore, liquefied natural gas (LNG) and gas condensate accounted for 20.5 million tons of cargo, making it the largest category, followed by oil and petroleum products with 7.22 million metric tons (Humpert 2023).

As rightfully judged by Moe (2014, 788), as of now, there is no stable cargo pattern to predict new shipments that will determine the long-term future of the NSR, especially in terms of the containership industry. Despite the predictions that from 2005 to 2030, the container volume from Asia to Europe will increase by 600% (Verny & Grigentin 2009, 109), it does not seem to take the NSR as a potential shipping corridor seriously. In addition to that, the NSR Is yet to experience exposure to the logistics of empty containers back to Asia, which will increase with time.

It could be concluded that while the shipping activity does take place on the NSR and shows patterns of growth and international interest, container shipping, as emphasized by Mietzner (2015,

119), “barely exists” with very few exceptions. Nevertheless, shortening the voyage from Japan to Germany can offer the financial potential for economies of scale which will be discussed further.

2.2 Barriers and threats preventing fully accessing the NSR for international commercial trade

The primary objective of this chapter is to provide an overview of the existing and potential obstacles that hinder the complete accessibility of the NSR for international commercial shipping. The matrix presenting all major threats concludes this section of the thesis.

2.2.1 Ice contents

Arguably the biggest factor preventing the NSR from being fully accessible is the fact that for the majority of the calendar year, it is covered by ice, making it impossible to navigate through for open water vessels. Despite the ice constantly melting (in 1988, the majority of ice present in the Arctic region was between four and ten years old, indicating a relatively stable and established ice cover. However, by 2005, there was a significant shift, and the majority of ice observed was less than four years old (Humpert 2011)); it still remains a vast environmental barrier.

The Russian Arctic areas experience significant interannual variability in terms of sea ice conditions. The western and eastern parts of the NSR are influenced by relatively warm currents from neighboring oceans, which can lead to less extensive sea ice coverage. In contrast, the interior region of the NSR is much colder, resulting in thicker and more persistent ice. As a result, there is an uneven distribution of sea ice along the NSR.

The fluctuating and unpredictable nature of yearly ice conditions, coupled with regional uncertainties, presents significant challenges for ship navigation in the area. It requires careful planning, ice monitoring, and the use of icebreaker support to ensure safe passage. The dynamic nature of the ice conditions highlights the need for continuous monitoring and adaptive strategies for navigating the NSR (Meng, Zhang & Xu 2017, 4). Sailing through the open sea while ice is still floating on its surface is highly dangerous as ice can strike the vessels carrying furls, thus creating oil spills and damaging the environment.

As of now, the navigable period on the NSR is limited to be from around late May - early June to around Late September - early October. The short and restricted duration of navigation along the NSR poses economic concerns for shipping companies. The limited shipping period, primarily due to ice conditions, creates uncertainty and inconsistency in regular shipping operations. This can be a significant barrier for shipping companies, especially those involved in container transportation (Lee & Kim 2015, 267).

In regards to the question, “When can any major improvements in terms of ice content be expected,” Humpert (2011) refers to the study by the Arctic Council claiming that it is estimated that by 2080, the NSR will be navigable without the assistance of icebreakers for a period of approximately 90-100 days. This means that during this limited timeframe, ships could navigate along the route without the need for icebreaker support. However, it is important to note that even with this extended ice-free period, year-round operations on the NSR cannot be guaranteed. The remaining months would still require icebreaker assistance for safe navigation due to the presence of ice. The specific ice conditions and the duration of the ice-covered period can vary from year to year, making it difficult to establish a consistent and reliable year-round shipping schedule. Figure 7 presents a projection of sea ice concentration for the years 2010-2019 and 2030-2039.

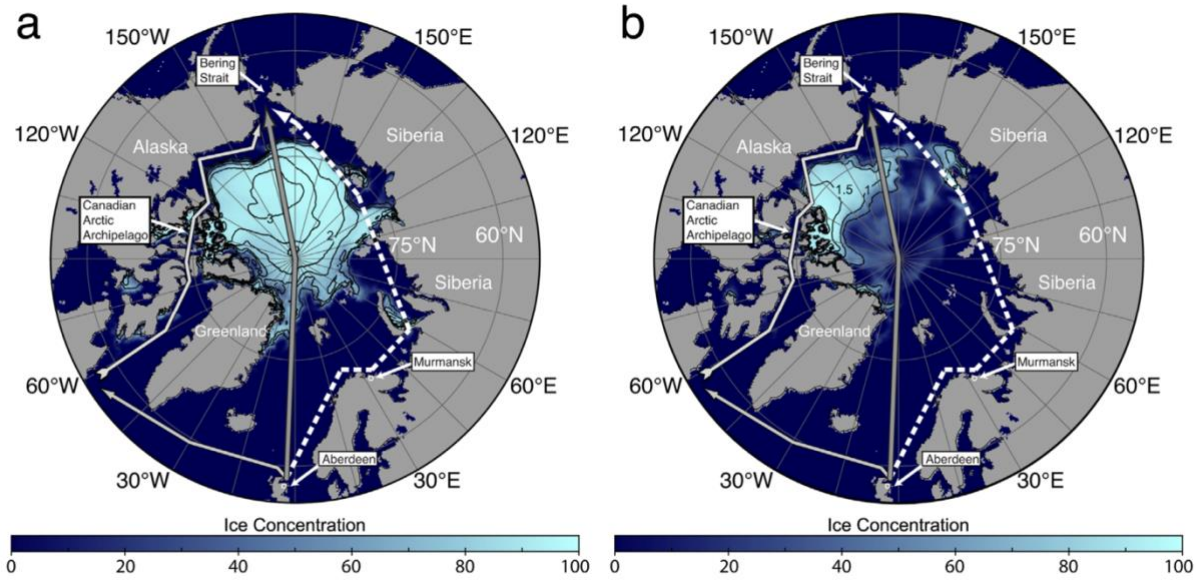

Figure 7. Sea ice concentration and thickness during the navigation period (June–October) 2010-2019 (a) and 2030-2039 (b) (Aksenov & al. 2015, 5)

2.2.2 Infrastructure

The lack of adequate infrastructure along the NSR poses a significant barrier for international shippers. The majority of the route traverses remote and harsh regions of Russia, characterized by severe weather conditions and a sparse population. The absence of developed ports, navigational aids, search and rescue capabilities, and other essential infrastructure hinders the establishment of a stable, safe, and predictable shipping environment.

For transportation companies, a well-developed shipping network and infrastructure are crucial. Multiple port calls are often necessary for loading and unloading cargo, ensuring efficient logistics

and supply chain operations. However, the limited availability of ports and support services along the NSR complicates the logistics and reliability of container shipping in particular. This lack of infrastructure restricts the ability of shippers to rely on the NSR as a viable alternative to established shipping routes.

Container shipping is a highly organized and time-sensitive industry that relies on regular schedules known as liner service. The majority of cargo ships, including more than 6,000 vessels, operate on these fixed routes, calling at multiple ports to load and unload cargo along the way. This system allows for efficient planning, coordination, and synchronization of supply chains, supporting the global economy.

For container ship operators, the ability to schedule journeys well in advance and ensure uninterrupted service is crucial. Just-in-time cargo deliveries are essential for many industries, as they help minimize inventory costs and maximize operational efficiency. Delays or disruptions in shipping schedules can have significant consequences, leading to production delays, increased costs, and customer dissatisfaction.

However, when it comes to the NSR, the limited navigation period and inadequate infrastructure pose challenges to maintaining regular and reliable liner service. The unpredictable ice conditions, restricted shipping season, and the lack of developed ports and support services make it difficult for container ship operators to integrate the NSR into their existing schedules and guarantee uninterrupted service (Humpert 2011).

To ensure the safety and efficiency of shipping along the NSR, it is crucial to establish well-equipped emergency stations at strategic locations along the entire route. These stations would enable prompt response to any ship emergencies that may occur due to the remote and challenging nature of the NSR. Additionally, infrastructure improvements should focus on the modernization of ports, enhancing navigational infrastructure and hydrography, upgrading ice navigation systems, and improving communication systems (Gunnarsson & Moe 2021, 24). However, it should be mentioned that Russia’s attempts to make the NSR more attractive include the creation and development of a satellite-based navigation system GLONASS (alternative to GPS), which hypothetically should solve the issue of communication in high latitudes.

The infrastructural issue also involves the issue of icebreakers. Currently, only Russian icebreakers are allowed to escort ships along the NSR, most of them being diesel-powered, and only 5 of them are nuclear (Milaković & al. 2018, 55-57). However, only 4 of them are in operating condition, and the overall fleet is aging (Moe 2014, 794). Moreover, given the plans of the Russian government to develop its own ports on the shoreline of the Arctic Ocean, it is highly likely that the

icebreakers will be heavily occupied in natural resource projects. This, in return, can also potentially cause an increase in accidental events in the open sea and increase the waiting time for transits, therefore, destroying the time-saving benefits of the NSR.

2.2.3 Insurance and operating costs

Due to the relatively young and less established nature of the NSR compared to the Suez Canal, there are certain additional costs associated with using this route. One of the main costs is the requirement for premium ship insurance to ensure the safety of vessels navigating through challenging Arctic conditions. Additionally, operational costs are likely to increase due to the need to ice-strengthen the ships to a certain extent and carry extra fuel. The limited number of ports along the NSR for refueling necessitates the need to store more fuel onboard, which can add to the operational expenses. These additional costs reflect the unique challenges and infrastructure limitations of the NSR compared to more established shipping corridors.

Operating in remote regions with harsh climatic conditions, such as the NSR, inevitably leads to higher insurance premiums for cargo ship operators. The challenging environment and potential risks associated with navigating through icy waters and extreme weather conditions increase insurance costs (Humpert 2011). Insurers take into account factors like the vulnerability of vessels to ice-related damages, the availability of search and rescue services in remote areas, and the potential for delays or disruptions due to adverse weather conditions. These factors contribute to the higher insurance premiums that cargo ship operators must pay to ensure coverage and mitigate the risks involved in operating along the NSR.

According to Drewry (2016), the costs of Hull and Machinery (H&M) in the shipping industry, including operations along the NSR, are expected to rise at rates higher than typical inflation. This implies that ship owners and operators should anticipate increased expenses for maintaining, repairing, and insuring their vessels. The unique nature of operating in harsh Arctic conditions, the necessity for ice-strengthened hulls, and the inherent risks associated with navigating through icy waters all contribute to the elevated H&M costs. These financial considerations reflect the distinctive challenges and requirements of conducting operations in remote and extreme environments such as the NSR.

2.2.4 International and reputational aspects

Given that the NSR largely traverses Russian waters, it is evident that Russia holds a crucial role in the development and management of the route. As the sovereign nation responsible for the region, Russia has the authority to regulate and oversee activities along the NSR, including navigation, infrastructure development, and safety regulations.

However, Russia's recent activity on the international scene resulted in the economic sanctions imposed by the United States and the European Union in 2014 following the Ukraine crisis, along with Russia's countersanctions. It created geopolitical tensions and protectionist measures. These events had a significant impact on the shipping industry, particularly in terms of investment decisions and long-term commitments.

The uncertain political and economic environment resulting from the sanctions and countersanctions made European shipping companies hesitant to engage in NSR ventures that would require substantial investments in new vessels. The risks associated with the sanctions and the potential for further geopolitical instability made it difficult for companies to justify the expenses and uncertainties involved in developing operations along the NSR (Gunnarsson & Moe 2021, 14)

As a result, the sanctions and geopolitical tensions acted as a discouragement for European shipping companies from actively participating in NSR projects. The long-term nature of investments in new vessels, ports, and the route overall, coupled with the uncertain and volatile business environment, made it challenging to secure the necessary support and commitments from European companies.

From the shipper's perspective, the NSR might carry reputational risks. Some major shipping companies and international brands have decided not to use the NSR or other Arctic routes due to projected environmental risks, potential impacts, and reputational consequences (Gunnarsson & Moe 2021, 25).

For these companies, the potential environmental and reputational costs outweigh the potential benefits of utilizing the NSR or other Arctic routes. They are committed to sustainable and responsible business practices, and they prioritize minimizing their ecological footprint and avoiding activities that could harm the environment.

2.2.5 Policies and regulation

Unlike the Suez Canal, whose regulation relies majorly on one short passage, the NSR is a large corridor; its administration is rather flawed at the current stage of development. Gunnarsson (2016) argues that currently, there is no single organization in Russia that has comprehensive oversight of all activities, services, and marketing related to the NSR. This lack of centralized administration and framework poses challenges in terms of analyzing efficiency, optimizing routes, coordinating traffic, and devising strategies to promote commercial activities. Additionally, there is a need for an organization that can determine tariff rates (which, in addition, are not always published systematically and remain confidential as per Moe (2014, 793)), forecast future NSR traffic and cargo volumes, and assess the demand for icebreaker assistance and other support services.

To address these issues, there is a call to expand and unify the role of the NSR Administration as well as its policies to encompass these additional services, similar to the role played by the Suez Canal Authority for the Suez Canal. This would involve consolidating authority and responsibility under a single entity that can effectively manage and facilitate various aspects of the NSR's operations and development. Finally, it is still quite rare to see that shipping companies would have NSR departments to handle and explore the potential route (Lee & Kim 2015, 268).

The barriers mentioned above, as well as other honorable mentions, are presented in Figure 8.

Figure 8. Barriers and threats preventing fully accessing the NSR for international commercial trade

3 Potential financial benefits of the NSR

Despite the challenges outlined in subchapter 2.2, the NSR does present the potential for reduced transit times from Asia to Europe, at least in theory. This chapter explores various models proposed by academics that aim to determine whether the NSR can offer cost reductions and effectively compete with the Suez Canal route, particularly in container shipping. The focus is on analyzing the feasibility of utilizing the NSR as a viable alternative and assessing its potential economic advantages compared to existing shipping routes. It should be mentioned, however, that accurate cost-saving prediction is rather complicated due to the lack of numerical data on the ships that traveled through the NSR. The main savings usually come from a reduction in fuel consumption by vessels.

3.1 Cost benefits of container shipping on the NSR

When discussing shipping costs, there are multiple factors affecting the price, which is prone to change on a constant basis. As there is not sufficient speed data for the NSR containership transits, most researchers assume it to be around 12 knots, given the sea condition. Figure 9 presents a framework of interrelated factors that contribute to the determination of shipping costs and time.

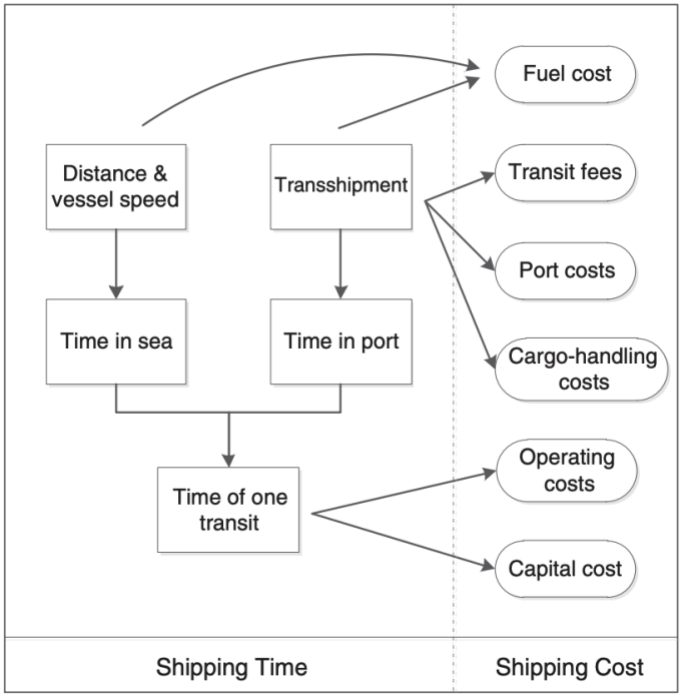

Figure 9. Shipping time and costs estimation framework (Zhang, Meng & Ng 2016, 3)

In the study conducted by Copenhagen Business School's Maritime Division, three types of containerships (8000 TEU, 10000 TEU, and 15000 TEU) were compared on the Suez Canal route and the NSR. The results of the study were not particularly optimistic for the NSR; however, it revealed that in a scenario with higher oil prices and reduced ice extent, the Arctic route becomes more competitive (Humpert & Raspotnik 2016).

While this study did provide valuable insights, the selection of the type of container ship presented in it seems quite exaggerated. The majority of other models were researching the benefits of using a 4000-5000 TEU container vessel. One of the most notable contributors in the field of NSR shipping and cost evaluation, Frédéric Lasserre, came up with a model comparing a 4500 TEU ship servicing on the NSR and the Suez Canal Route from Rotterdam to Shanghai and Yokohama. Based on his calculations, the cost of shipping one TEU along the NSR at the present day is 1278 USD and 820 USD through the Suez Canal route (Shanghai – Rotterdam). He assumed that the transit time through the NSR was 180 days. The absence of financial benefits is explained by rather high tariffs that the NSR administration imposes, as well as the fact that business in the Arctic region is generally going to be always more expensive. The positive side, however, is that the fuel cost per leg of transit is 20% lower. Another important factor is load level. It was argued that as long as the load level of the vessel along the NSR can be matched with the Suez Canal route, the savings could reach up to 11% (Lasserre 2014, 154-155). With the current conditions, NSR container shipping can only offer a 2,3% decrease in unit profit (Zhang & al. 2016, 7)

A similar study conducted by Liu and Kronbak (2010) looked at the economic viability of shipping the 4300 TEU ship on the NSR. They made an effort to calculate the profit assuming year-round service. The results that they arrived at were such that even though the NSR can potentially generate more revenue than the Suez Canal route (on average from 1 to 6 million USD), with the current tariffs and tolls, Arctic shipping cannot compete with the Suez Canal route, no matter how many days are navigable. The NSR can become profitable only if the ice-breaker fee is reduced by at least 50%, which given the current situation, does not seem very likely (Liu & Kronbak 2010, 442-443). It is important to mention as a side note that the ice-breaker fee is determined by the size of the transiting vessel, its ice class, route, and the level of requested support.

In terms of fleet number, mathematically speaking, with a route with stops in Shanghai, Busan, Tokyo, and Hamburg, six ships should be enough to ensure departure from each port every week. This assumption does not take into account the potential environmental and trading barriers that were discussed previously; thus, from a ship owner's perspective, it should indicate the need for a buffer fleet. As for the operational costs, for a 4000 TEU container carrier, they could reach as high

as 130,000 USD per day which makes it almost prohibitive for Arctic shipping, especially given the fact that only 30% of the NSR transits are eastbound (Verny & Grigentin 2009, 113-115). As far as voyages per vessel throughout the year, Eliseev and Naumova (2020, 175) estimate a maximum of 16 transits in the most optimistic international scenario

One specific operational expense that increases is the crew salary. Due to the unique challenges and requirements of operating in the Arctic region, crews on board vessels navigating the NSR require higher qualifications, technical training, and experience. As a result, they command higher wages compared to crews on other routes. The specialized skills and knowledge needed to navigate through icy waters and handle potential Arctic-specific situations justify the higher compensation for the crew members (Zhao, Hu & Lin 2016, 56). This study also examined the tolls and tariffs associated with both routes and highlighted that the predicted tariff for a 4800 TEU containership on the Suez Canal route is around 310,000 USD. In contrast, historical data suggests that tolls on the NSR can reach up to 1,000,000 USD for a ship of the same size. As a result, the study concludes that the Arctic route would still generate less profit compared to the Suez Canal route. It appears that the NSR only becomes a competitive option when the fees are decreased to 240,000 USD with a service frequency of 9 ships.

Table 5 presents an overview of key findings from the mentioned simulations and research, comparing the NSR cost efficiency with the Suez Canal route (note: containerships with a capacity of 4000-5000 TEU are considered).

Table 5: Key financial comparison results between the NSR and the Suez Canal route

Comparison metric	The NSR	The Suez Canal route
Cost per unit Rotterdam – Shanghai, discounted tariffs (Lasserre 2014, 153)	879 USD	806 USD
Total transported (Lasserre 2014, 153)	20,700	19,845
Fuel cost per transit (Lasserre 2014, 153)	7,830 thousand USD	8,173 thousand USD
Fees (Lasserre 2014, 153)	2,310 thousand USD	1,440 thousand USD
Unit profit per TEU (Zhang & al. 2016, 8)	1,124 USD	1,150 USD
Annual revenue assuming a 50% reduction in ice-breaker fee (Liu and Kronbak 2010, 443)	34,658 thousand – 39,517 thousand USD	33,153 thousand USD
Operational costs (Zhao & al. 2016, 56)	3,228 thousand USD	2,236 thousand USD

At its present state of development, the NSR faces significant challenges that prevent it from being a viable competitor to the Suez Canal as a standalone route. The restricted navigable period, high ice-breaking fees, and overall tariffs are key factors that undermine its competitiveness. Additionally, concerns about the load factor and the complex nature of Arctic shipping contribute to increased operational costs. These combined factors place the NSR at a disadvantage compared to the established Suez Canal route.

3.2 The NSR-Suez Canal mixed shipping model

The current economic potential of the NSR, both currently and in the near future, may lie in its role as a supplementary and complementary option to the well-established Suez Canal route. Rather than competing directly, the NSR can serve as a niche alternative in specific circumstances. By offering a shorter and more direct route for certain types of cargo and during favorable ice conditions, the NSR can provide added value and flexibility to shipping companies. This model allows the NSR to complement the Suez Canal route, catering to specific needs and optimizing overall shipping efficiency.

In various studies, the concept of combined shipping, where vessels utilize both the NSR during warmer months and the Suez Canal route during colder months, has been proposed as a realistic scenario for Arctic shipping. This approach takes advantage of the navigable seasons of each passage, maximizing efficiency and reducing costs. By strategically planning and coordinating transits between the NSR and the Suez Canal route, shipping companies can optimize their operations, adapt to seasonal variations, and overcome the limitations of each individual route. This combined shipping model offers a practical solution for leveraging the strengths of both corridors and ensuring more reliable and efficient transportation throughout the year.

The common platform proposed by Furuichi and Otsuka (2015) revealed that when combined, the two routes can indeed offer a competitive advantage to the conventional way of intercontinental sailing. Specifically, they looked at scenarios when the NSR is available for 105 and 225 days a year.

In the base scenario, with a 105-day NSR service period, the unit cost of NSR/ Suez Canal route-combined shipping using a 4000 TEU ice-class ship was calculated at 1211 USD per TEU. This cost is competitive against Suez Canal route shipping, which is estimated at 1355 USD per TEU using an ordinary 4000 TEU ship. However, it's important to note that container ships operating between East Asia and Northwest Europe have been transitioning to larger vessels, such as 6000-8000 TEU or ultra-large 15,000 TEU ships. This shift in ship size significantly impacts the

competitive advantages of the NSR/ Suez Canal route -combined shipping with a 4000 TEU ice-class ship. This finding is emphasized in Figure 10.

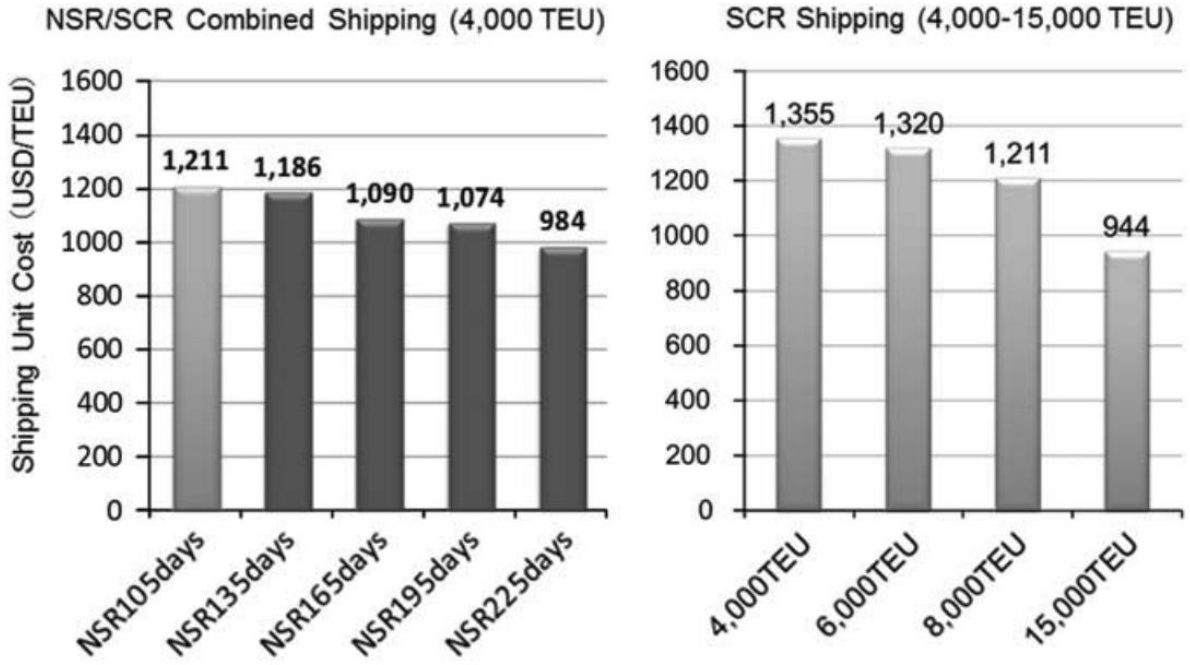

Figure 10. Shipping cost per container comparison between NSR/ Suez Canal route-combined shipping and Suez Canal route shipping (Furuichi & Otsuka 2015, 21)

When implementing NSR/Suez Canal route-combined shipping, it is possible to achieve a higher number of annual voyages compared to using either route individually. Depending on the service period of the NSR (ranging from 105 to 225 days), combined shipping enables 13 to 15 voyages per year. In contrast, Suez Canal route shipping alone allows for 12 annual voyages. By utilizing a 4000 TEU ice-class ship, the combined shipping model can achieve annual container shipments of 33,600 TEU/year, surpassing the capacity of SCR shipping. As the number of annual voyages increases, the potential container shipment increases to 36,400 TEU/year (108.3% of SCR capacity) for 13 voyages, 39,200 TEU/year (116.7% of Suez Canal route capacity) for 14 voyages, and 42,000 TEU/year (125.0% of Suez Canal route capacity) for 15 voyages. This demonstrates the increased efficiency and capacity utilization that can be achieved through NSR/ Suez Canal route -combined shipping. The results of the proposed platform are condensed and adopted in Table 6.

Table 6: Comparison model of NSR/ Suez Canal route-combined shipping with conventional shipping method (adapted from Furuichi & Otsuka 2015, 21-27)

Ship size	4000 TEU	4000 TEU	4000 TEU
NSR availability	0 days (365 days on Suez Canal route)	105 days (260 days on Suez Canal route)	225 days (140 days on Suez Canal route)
Annual voyages	12	13	15
Annual container capacity	33,600	36,400	42,000
Unit cost per TEU (depending on fuels costs)	945-1648 USD	856-1464 USD	984 USD

As mentioned earlier, the Suez Canal route can accommodate larger container ships, such as those with capacities of 8000 TEU and above. These larger ships can take advantage of economies of scale, resulting in more cost-effective operations, especially when tolls on both routes are equal (Xu, Yang & Weng 2018, 12-15). Therefore, traditional shipping methods using the Suez Canal route will generally be more economically viable. However, if the NSR administration reduces fees significantly and there is a substantial increase in fuel prices, a combined NSR/ Suez Canal route service could become a promising alternative.

4 The Northern Sea Route and environmental sustainability

As Kuori Oy focuses on implementing sustainable practices in its operations, it is crucial to consider the environmental aspects of shipping via the NSR. This chapter will provide an assessment of the environmental impact associated with NSR shipping and highlight both the potential benefits and challenges.

Environmental concerns are a significant barrier to the complete utilization of the NSR. The Arctic region is a fragile ecosystem, and increased shipping activity can have detrimental effects on the environment.

One can argue that using the NSR can potentially result in a reduction in CO2 emissions compared to the Suez Canal route. The shorter distance traveled along the NSR, particularly during an extended service period, can contribute to lower CO2 emissions.

The actual reduction in CO2 emissions will depend on various factors, including the vessel's fuel efficiency, speed, and the distance saved by utilizing the NSR. Studies have estimated that deploying a 4000 TEU vessel on the NSR instead of the Suez Canal route can lead to CO2 emission reductions ranging from 14 to 35 percent. This reduction deals with reduced fuel consumption, which is enabled by the shorter distance traveled along the NSR (Furuichi & Otsuka 2015, 27).

It is essential to consider that while the NSR offers potential environmental benefits in terms of CO2 emissions reduction, other environmental concerns related to Arctic shipping must be considered.

4.1 Biodiversity concerns in scope on the NSR

The presence of open-water vessel transits along the Arctic Sea routes poses a risk to Arctic marine mammal subpopulations. More than half of the Arctic marine mammal subpopulations, including species like narwhals and polar bears, are exposed to these vessel transits. Narwhals are considered the most vulnerable due to their high exposure and sensitivity, while polar bears are estimated to be the least vulnerable. Regions with geographic bottlenecks, such as the Bering Strait and the eastern Canadian Arctic, have higher vulnerability compared to more remote regions. In response to the potential impacts of the developing shipping industry, the Arctic Council has recommended the identification and assessment of areas of ecological importance. However, the implementation of specific guidelines is hindered by limited data. Nonetheless, there are ship-based measures that can be taken to minimize environmental consequences, such as avoiding key habitats through routing, detecting and deviating from visible whales, and minimizing sound

production. These measures can be further improved by restricting vessel speed. It is worth noting that some species and regions identified as less vulnerable still have high uncertainty, indicating the need for additional data and monitoring. This highlights the importance of ongoing research and assessment to better understand and mitigate the potential environmental impacts of Arctic shipping (Hauser, Laidre & Stern 2018, 1)

Figure 11 clearly demonstrates what species are at the most risk when exposed to the NSR vessel traffic

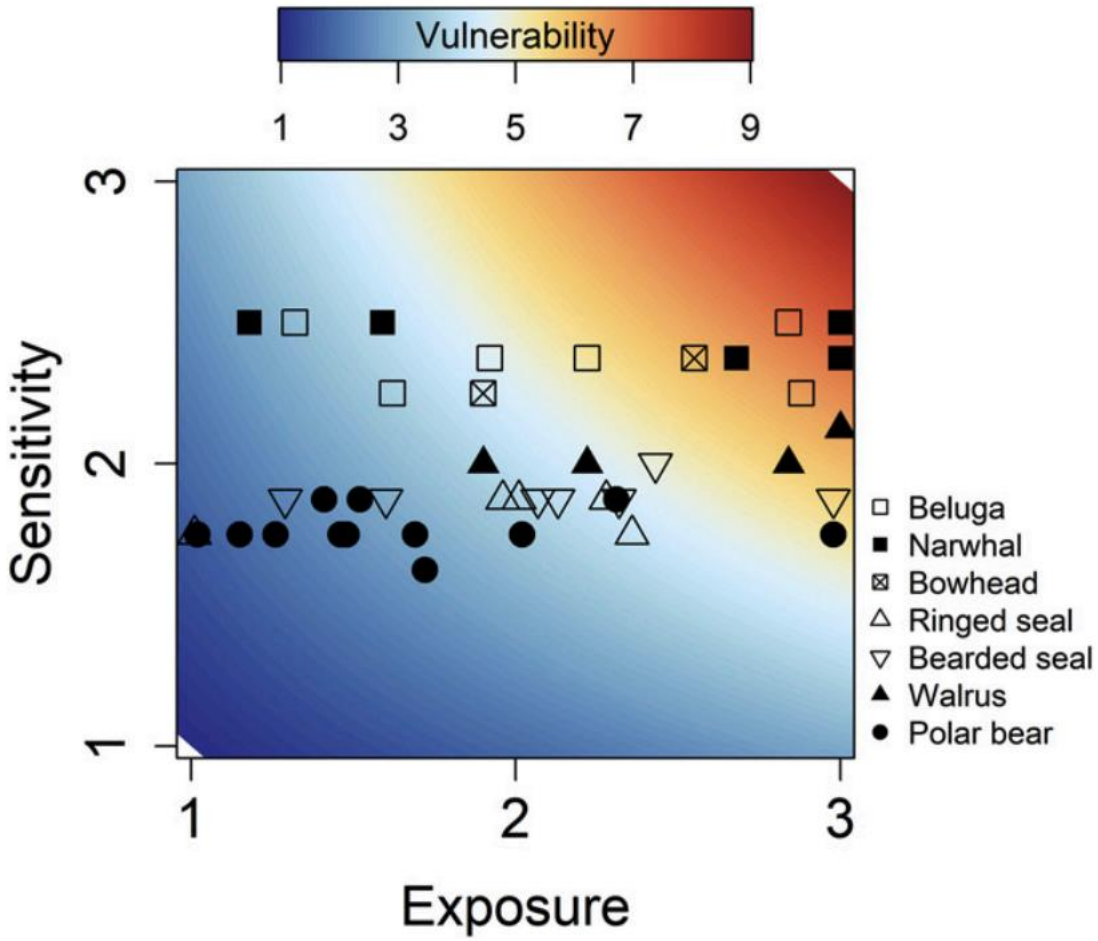

Figure 11. Vulnerability of Arctic mammals in terms of NSR vessel traffic (Hauser & al. 2018, 2)

4.2 Fuel emissions on the NSR

The use of marine diesel fuel in Arctic shipping contributes to the emission of black carbon (soot), which has a significant negative impact on the environment. This pollution affects both human health and ecosystems through snow and ice pollution. The establishment of infrastructure, including ports and industrial zones, further contributes to the environmental footprint. Air pollution

resulting from these activities has dual consequences, with both immediate health and economic risks as well as long-term implications for the global climate. With the projected increase in Arctic shipping, the negative effects of air pollution are expected to increase.

In order to mitigate emissions, the adoption of alternative fuels like liquefied natural gas has shown potential. Switching to alternative fuels can lead to substantial reductions in particulate emissions, with potential reductions of up to 67%. By moving away from traditional solid and liquid fuels such as coal and fuel oil, which contribute to pollution, and implementing organizational and technical measures for energy supply, the environmental situation in the Arctic can be improved.

Monitoring the environmental conditions in ports, where ship congestion and emissions are concentrated, is crucial. Additionally, there is a need to model and prepare for hazardous situations resulting from accidents at potentially dangerous facilities. Developing information and analytical systems to support emergency planning and response is essential. Promoting environmental awareness among urban populations and fostering personal responsibility for maintaining ecological balance are important steps. However, effective mitigation efforts require active and genuine support from the government.

The development of Arctic resources, trans-Arctic maritime trade, and increased tourism brings new opportunities but also raise concerns for the indigenous peoples of the Arctic. It is vital to protect the interests and well-being of these communities as the region undergoes further development. Safeguarding their rights, culture, and livelihoods should be a priority to ensure a sustainable and inclusive future for the Arctic (Makarova & al. 2022, 2-13).

4.3 Oil spills on the NSR

Assessing the risk of oil spills in Arctic regions, particularly along the NSR, presents significant challenges. The effectiveness of traditional oil spill response systems, which rely on onshore facilities (although some facilities are present on boards of ice breakers), is uncertain when ice is present in the area.

Accidents involving tankers pose a potential risk of large oil spills along the NSR. Gas condensate has been the dominant liquid cargo transported along the NSR in recent years, and its significance is expected to continue due to the development of major gas production projects in the Yamal and Kara Sea regions. However, there has been a lack of attention given to modeling gas condensate spills in cold and ice-covered waters, developing specific spill response technologies for gas condensate, and studying the impact of gas condensate pollution on Arctic ecosystems.

It is essential to develop models that can assess the potential consequences on important marine and coastal areas and devise oil spill response strategies using efficient technologies within the limited time available in the Arctic. Adequate focus and research are required to bridge these knowledge gaps and ensure the implementation of effective measures to safeguard the delicate Arctic ecosystem from oil spills (Bambulyak, Von Bock und Polach, Ehlers & Sydnes 2014, 3-7)

Environmental concerns present a significant barrier to fully utilizing the NSR. To address this, strict regulations, sustainable practices, and collaboration among stakeholders are needed. Using cleaner fuels, implementing emission reduction technologies, minimizing oil spill risks, and conducting environmental impact assessments are crucial. The NSR can be developed sustainably by prioritizing environmental preservation while reducing its ecological footprint.

5 The NSR supply chain and the Nordics

This chapter explores the potential for Nordic countries and businesses to engage in the development and future utilization of the NSR. The author provides their reflections on this possibility, examining the opportunities and challenges that lie ahead. A SWOT analysis from the Nordic perspective is presented at the end of the chapter.

5.1 Historical shipping activity of the Nordic companies on the NSR

In addition to the previously discussed Danish-flagged container ship, it is noteworthy that Finland has also been involved in shipping activity along the NSR. For example, in 1995, when sea ice extent was more severe compared to the present, a tanker named "Uikku" traveled from Finland to the Pacific Ocean using the NSR route. This demonstrates early instances of Finnish engagement with the NSR for maritime transportation.

In the more recent period from 2010 to 2013, it is documented that Nordic shipping companies played a significant role in the utilization of the NSR. Approximately 49% of all voyages during that time were carried out by Nordic companies. Specifically, Danish bulk carriers, Marinvest from Sweden and Neste Oil Company from Finland, were actively involved in NSR shipping.

However, it's important to note that their shipping activities primarily revolved around spot-market deliveries, meaning they were focused on short-term contracts rather than long-term commitments. This highlights the cautious approach taken by these companies in exploring the NSR as a viable shipping route (Gunnarsson & Moe 2021, 8-21).

5.2 NSR’s potential benefits for the Nordics

Norway's geographical proximity and exposure to the Arctic position it well to benefit from the development of the NSR. Its favorable location gives Norway easier access to the NSR compared to Finland, Sweden, and Denmark. As a result, Norway is expected to experience significant advantages, including new business opportunities and labor market development.

As a result, Norway is expected to experience significant benefits, including new business opportunities and labor market development along its shoreline. Norway's ports are well-prepared and equipped to accommodate for vessel traffic from the Arctic, which positions the country as a potential transshipment hub in the future. Nevertheless, it is important to recognize that other Nordic countries can also play significant roles in the Arctic shipping industry. While they may not have the same geographical advantages as Norway, these countries can leverage the synergies of their interconnected railroads to become key players in Arctic shipping.

Establishing and maintaining close collaboration among the countries and the businesses representing them is crucial to ensure mutual benefits and successful cooperation at all stages of development. This collaborative approach will be essential in unlocking the full potential of the NSR and fostering a sustainable and prosperous Arctic shipping industry (Solvang & al. 2015, 501-508).

Norway's geographical proximity and exposure to the Arctic position it well to benefit from the development of the NSR. Its favorable location gives Norway easier access to the NSR compared to Finland, Sweden, and Denmark. As a result, Norway is expected to experience significant benefits, including new business opportunities and labor market development along its shoreline.

The Norwegian port of Kirkenes has emerged as a potential transshipment hub, drawing increasing attention in discussions about Arctic shipping. The infrastructure strategy includes indications of a possible railway line connecting Rovaniemi, Finland, to Kirkenes on the Norwegian coast of the Barents Sea. The transport plan highlights that if Finnish state authorities initiate an assessment of the railway connection, Norwegian authorities are positive about contributing to the project. In recent years, Finnish authorities have expressed a growing interest in establishing this connection to Kirkenes.

Notably, in October 2015, Olli Rehn, former EU commissioner and Finnish Minister of Economics at the time, emphasized the desire for a railway connection between Berlin and the Arctic Ocean, further highlighting the interest in enhancing transportation links to the Arctic region. The potential railway connection between Finland and Kirkenes could significantly facilitate trade and transportation activities in the Arctic, contributing to regional development and connectivity (Staalesen 2017). In addition to that, it could also strengthen Finland’s position in the NSR development despite not having direct access to the Arctic.

Figure 12 shows a possible outlook of the integrated supply chain consisting of the NSR and Nordic railway.

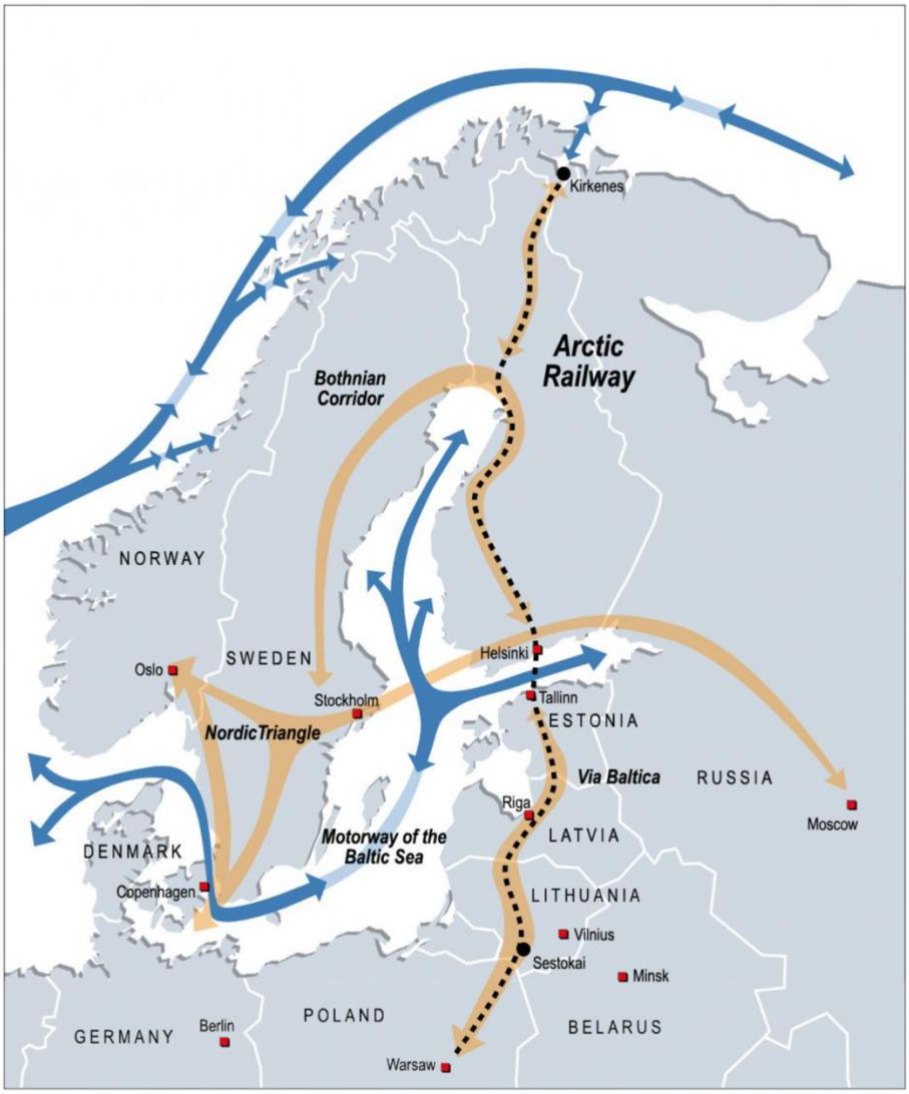

Figure 12. The NSR's integration into the supply chain of the Nordics (Eilertsen 2018)

The likelihood of Nordic companies using the NSR in the future depends on several factors. While there is growing interest and potential for increased shipping activity in the Arctic region, the actual adoption of the NSR by Nordic companies will depend on various considerations.

Some factors that may influence this likelihood include the development of infrastructure and support services along the NSR, improvements in navigational safety and risk management, the availability of icebreaker support, regulatory frameworks and policies governing Arctic shipping, economic viability, and cost-effectiveness compared to alternative routes, and environmental sustainability considerations.

Overall, while the NSR offers potential advantages in terms of shorter transit times and reduced shipping distances, the decision to use it will depend on a range of economic, logistical, environmental, and regulatory factors. The future utilization of the NSR by Nordic companies will

likely be influenced by a careful assessment of these factors and the potential benefits and risks associated with Arctic shipping.

Figure 13 presents a SWOT analysis of NSR utilization from the perspective of Nordic countries, companies, and shippers.

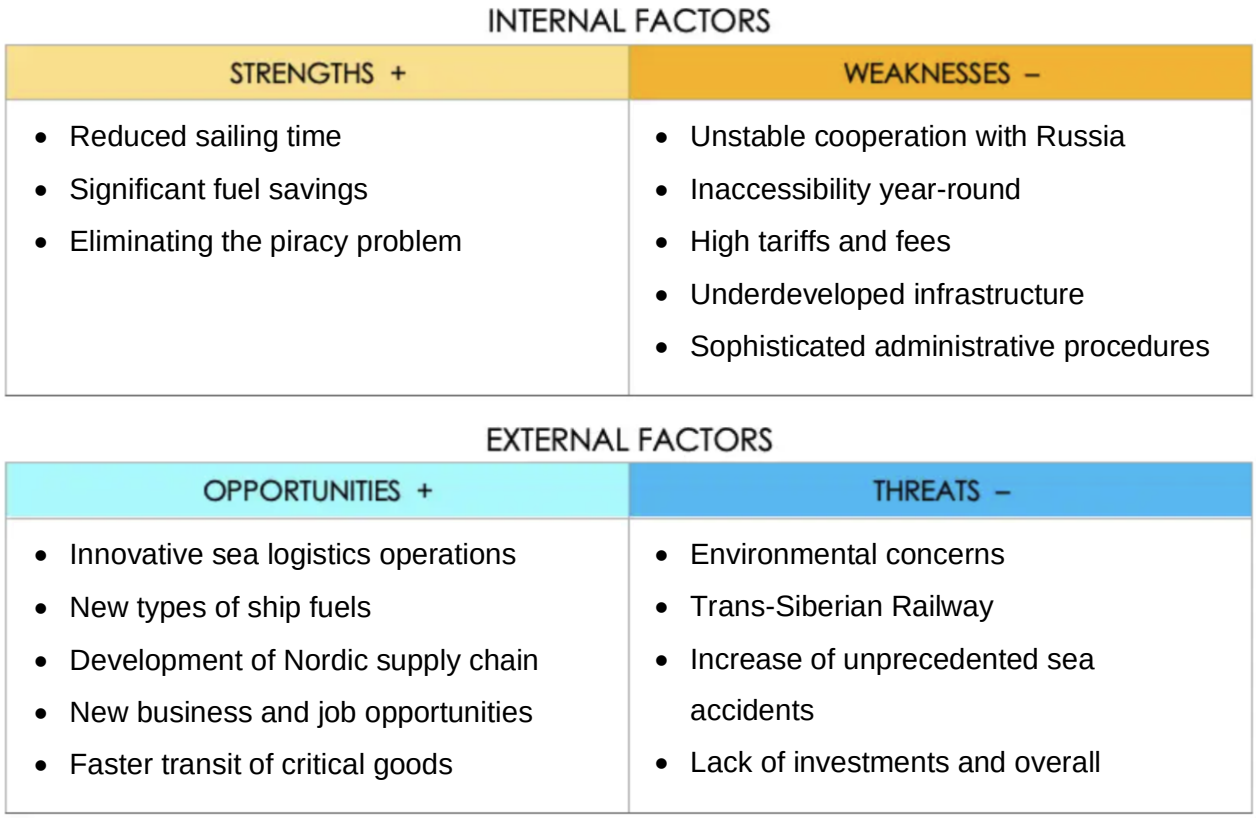

Figure 13. NSR SWOT analysis from the Nordic perspective

6 Research methods

This academic work is structured into two main parts. The first part, comprising chapters 2 to 5, focuses on theoretical research. These chapters provide a comprehensive background to the researched topic by synthesizing and presenting data gathered from various academic sources. The theoretical research serves to enhance the reader's understanding and knowledge of the subject.

The second part of the thesis involves empirical qualitative research. The author designed and conducted interviews with professionals in Supply Chain Management with extensive experience and a proven track record. The author then analyzed and interpreted the data collected from these interviews. The interviewees that took part in this research were a professor of Supply Chain Management from a Finnish University of Applied Sciences, a Senior Director of Corporate Communications from Hapag-Lloyd, Head of an international logistics company. Two interviews (Interviews A, B) were held on via the online meeting platform “Microsoft Teams,” and one interview (Interview C) was completed in a face-to-face manner.

A list of questions and topics for discussion was designed prior to interviews. During the interviews, the author also proceeded with follow-up questions depending on what the interviewee’s response was. Throughout the interview, the author took notes of the interviewees’ responses in order to later interpret them and present them in the thesis. The full questions and their outcomes can be found in Appendix 1. It should be mentioned that the questions listed in Appendix 1 served as orienteers for the author. Based on the responses and knowledge of each interviewee, the author then adjusted the interview process and follow-up questions (they are not present in the appendix). Instead of direct quotations, Appendix 1 comprises the main points and thoughts expressed by each respective interviewee.

In the upcoming chapter, the results of the empirical research will be presented, and the answers to the research question and investigative questions will be unveiled. These findings will ultimately lead to a conclusion for the work, summarizing the key insights and outcomes of the research.

6.1 Research design

Figure 14 presents a visualization tool specifically designed to outline and organize the research design. This tool serves as a roadmap, guiding the author through each phase of the research process, starting from general concepts and progressing to more specific topics.

By utilizing this tool, the author can ensure that all essential aspects of the research project are addressed effectively, maintaining a structured and logical approach. The tool aids in maintaining focus and adherence to the research plan, resulting in a comprehensive and well-executed study.

During the study, the first part focused on desktop research, which involved reviewing peer-reviewed research literature and interpreting its findings in a way that is applicable to the commissioning company. This part aimed to provide insights and information related to each Investigative Question.

In the second part of the study, qualitative data was collected through personal interviews. This stage aimed to address three out of the four Investigative Questions. However, Investigative Question 3 was discussed in less detail during the interviews as the interviewees were not experts in the environmental aspect of Supply Chain Management.

Combining the findings from the desktop research and the insights gained from the personal interviews, the study aimed to provide a comprehensive understanding of the research topic and effectively address the Investigative Questions.

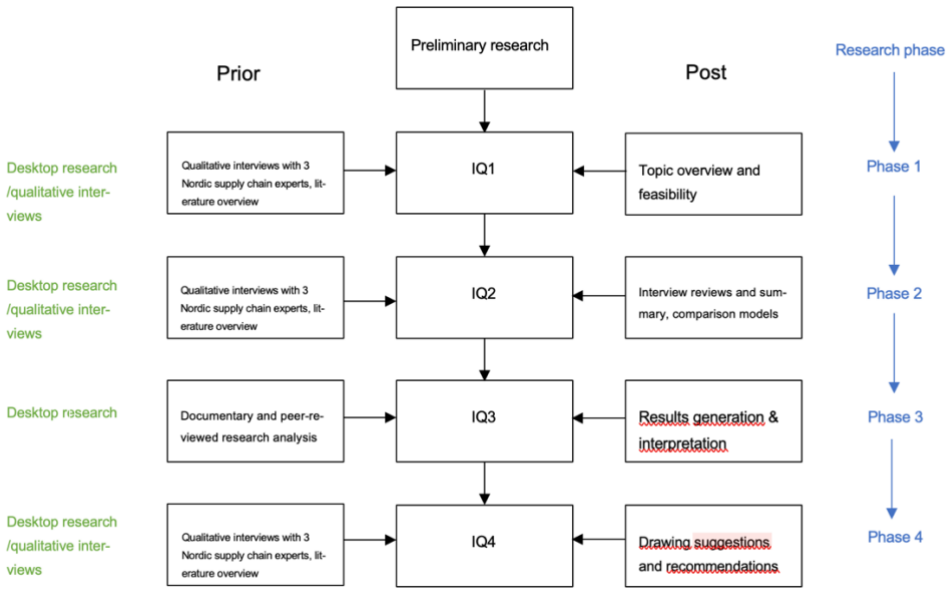

Figure 14. Research design

6.2 Reliability and validity of the qualitative interviews

In order to appropriately conduct an interview, the questions were phrased clearly, so that the interviewee could understand them and asked in a neutral tone. The use of open questions also helped to avoid bias, as per Saunders, Lewis & Thornhill (2019, 456).

During answering, the respondents were not interrupted, and after the answer, comments of the interviewer were avoided to not lead or influence the interview by revealing any form of dis-/approvement. In addition, after the final context-related question and answer, the experts were given the possibility to add anything they felt was missed during the immediate answer or that they felt was left out by the author. However, this was not made use of due to lack of necessity in the eyes of the conducted. Validity was ensured by the choice of interviewees.

7 Results

This subchapter provides a summary of the results and analyzes the findings from the conducted interviews. The purpose is to answer Investigative Questions 1, 2, and 4 based on the information gathered.

7.1 IQ 1. What is currently preventing the Northern Sea Route from being fully available for commercial cargo transit, and when will it be fully accessible?

During the interviews conducted, it was noted that all three interviewees had a strong understanding of the topic of Northern Sea Route shipping. This level of familiarity allowed the author to bypass extensive explanations about the NSR itself and delve directly into discussing the challenges that prevent its full utilization.

One of the most mentioned challenges by the interviewees was the political pressure faced by European shipping companies. Many of these companies no longer have business dealings with Russia, and there may be reluctance or hesitance to engage in NSR shipping due to political considerations.

Furthermore, the current stage of NSR development presents significant risks for shippers. Safety and security concerns were highlighted as crucial factors that cannot yet be fully guaranteed along the NSR. This uncertainty raises doubts about the reliability and trustworthiness of the route for shipping activities. The lack of professional preparation in terms of infrastructure was also emphasized, which raises questions about the efficiency and effectiveness of utilizing the NSR as a time-saving alternative. These challenges contribute to a perceived higher level of risk associated with NSR shipping, which can deter companies from fully embracing its potential.

In addition, insurance costs were identified as a significant consideration for shipping activities on the NSR. Both the desktop research and the interview findings indicated that insurance costs are likely to increase for companies engaging in NSR shipping. This financial aspect adds to the overall challenges and costs associated with utilizing the route.

When specifically discussing container shipping, it was noted that the feasibility of such operations on the NSR remains uncertain soon. Currently, there is a lack of important and attractive ports along the NSR that can efficiently handle container traffic. The absence of suitable infrastructure and port facilities for container operations raises concerns about the practicality and viability of container shipping along the NSR.

These challenges, identified through a combination of desktop research and qualitative interviews, shed light on the various obstacles that need to be addressed to facilitate the full utilization of the NSR. They highlight the areas where further development, improvements, and collaborations are necessary to overcome the challenges and unlock the potential of the NSR as a viable shipping route.

7.2 IQ 2. What financial benefits can the Northern Sea Route potentially bring for companies that require sea transportation from/to Pacific Asia/Europe?

During the interviews, the potential benefits of the NSR were met with scepticism by the interviewees. They highlighted that container pricing is influenced by numerous factors beyond just speed of delivery. In fact, speed was not considered the most crucial factor for shippers, as serving the right ports along the route was deemed more profitable. This perspective challenges the notion that faster transit times offered by the NSR would automatically attract container shipping.

Furthermore, one of the interviewees mentioned that many ships are intentionally slowed down to reduce CO2 emissions and decrease fuel consumption. This sustainability-driven practice contrasts with the emphasis on speed, potentially diminishing the attractiveness of the NSR's time-saving advantage. Considering this scenario, the combined shipping model proposed in subchapter 3.2, which integrates both conventional and Arctic routes, emerges as a potential solution worth exploring. This model allows for optimizing shipping operations while considering environmental sustainability.

The capacity of containerships also poses a challenge to the profitability of shipping on the NSR. It was noted that sending smaller 4,000 TEU vessels through the Arctic may not be economically attractive compared to deploying larger containerships on conventional routes. The limited capacity of smaller vessels hinders cost efficiency and may not justify the use of the NSR for container shipping.

These insights shared by the interviewees reveal the complexities and considerations involved in evaluating the potential benefits of the NSR. It becomes evident that speed alone is not the sole determining factor for shippers, and a comprehensive analysis of various aspects, including pricing, sustainability, and vessel capacity, is necessary to gauge the profitability and viability of shipping on the NSR.

7.3 IQ 3. How likely are Nordic companies to start utilizing the Northern Sea Route, and what parties will it involve in the process

During discussions about the prospects of Nordic countries in the development of the NSR, the interviewees expressed a shared view that Nordic countries, including their companies, have limited influence in shaping the NSR's development. Instead, they identified major international shipping companies, ports, the Russian government, and the crude oil industry as the primary drivers of progress in the NSR.

Regarding the idea of Kirkenes becoming a transshipment hub, the interviewees expressed skepticism for several reasons. Firstly, they doubted the realization of this project in the near future due to its complexity, high cost, and relatively low demand in the current circumstances. The development of Kirkenes as a transshipment hub would require significant infrastructure investments and sufficient demand to justify the investment.

Additionally, one of the interviewees (Interview C) raised concerns about the potential impact of Singapore in the future. They suggested that Singapore could become the main container-ship hub in Asia, which would lengthen the NSR transit route. Currently, the NSR route is calculated based on ships departing from Shanghai or Yokohama. If Singapore emerges as a dominant container-ship hub, it could diminish the competitive advantages of the NSR by extending transit times and offering alternative routes.

These insights from the interviewees highlight the challenges and uncertainties surrounding the role of Nordic countries in the NSR's development. While Nordic countries may have limited influence, it is essential to consider the involvement of major international players, government policies, and evolving global shipping dynamics when assessing the potential future of the NSR and the viability of Kirkenes as a transshipment hub.

8 Conclusions

8.1 Key findings

The main objective of this thesis was to identify the potential financial benefits and environmental outcomes of utilizing the Northern Sea Route for commercial logistics between Asia and Europe and present them to the commissioning company, Kuori Oy. A specific stress was put on container shipping as, for the commission company, it is the primary way of transporting finished goods.

In order to find this out, a considerable number of academic research and peer-reviewed articles from the area of Supply Chain Management and Arctic shipping were reviewed and reflected upon in this paper. After the desktop research had been completed, a series of interviews with professionals from the Supply Chain industry was designed, implemented, and interpreted.

The research question (RQ) of the thesis, “What are the potential environmental and financial outcomes of utilizing the Arctic shipping route for commercial cargo transportation” was broken down into four investigative questions (IQs):

IQ 1. What is currently preventing the Northern Sea Route from being fully available for commercial cargo transit, and when will it be fully accessible?

IQ 2. What financial benefits can the Northern Sea Route potentially bring for companies that require sea transportation from/to Pacific Asia/Europe?

IQ 3. To what extent is the potential Northern Sea Route detrimental to the environment, specifically marine sustainability?

IQ 4. How likely are Nordic companies to start utilizing the Northern Sea Route, and what parties will it involve in the process?

Summarizing the research, it could be said that in the near future, Kuori Oy should not expect its logistics partners to revert and explore the possibility of Arctic shipping. Instead, for the next 10 to 15, the trading routes are likely to remain the same.

Currently, numerous barriers prevent ship owners and operators from engaging in NSR shipping. These barriers include inaccessibility of the route year-round, unstable political situation, substantial risks, high operating costs, and a severe lack of shipping infrastructure and facilities on the NSR (relates to IQ 1).

Another major concern, not only from the shipping perspective but also from a sustainability point of view, is the fact that the fragile region of the Arctic has never been exposed to major marine traffic yet. The consequences of this increased activity are unknown but are expected to be drastically detrimental to the Arctic environment, especially for its fauna. Air and water pollution will be extremely difficult to mitigate in the region unless the shipping companies start utilizing alternative fuel types (relates to IQ 3). It is also a huge reputational risk for shipping line operators in case of an accident or increased pollution.

As far as the economic benefits are concerned, they are almost non-existent if the NSR is compared to the conventional Suez Canal route. With the current passage of tariffs and ice-breaking fees, the NSR cannot compete with the southern route, which can also rely on gigantic container-ship to use the economies of scale. The real financial potential of the NSR lies in its being combined with the Suez Canal route. This model can hypothetically increase the overall tonnage of the goods transported and increase the number of voyages a year. However, once again, in order to make it possible, the NSR administration should lower its fees, and the route needs to become accessible for longer periods of time (relates to IQ 2).

Finally, it was indicated that the Nordic countries and the companies representing them are not going to be at the forefront of the NSR development. Unlike Russia, crude oil companies or big shipping lines do not have significant leverage, and only Norway has access to the NSR. Still, if the NSR can pick up the pace of its development and overcome the existing barriers, the Nordic could expect to reap the benefits of business-creating opportunities. This would require close cooperation and integration between the countries and companies (relates to IQ 4)

8.2 Suggestions for further research

As this research speculates about potential benefits and outcomes for a topic that involves such significant topics as international relations, financial benefit calculations and modeling, and marine sustainability, it needs a more in-depth and separate analysis of each respective area. For example, it could further be researched and compared to how different vessel types perform in cost simulations. Apart from that, other European countries should have been addressed, as the focus was primarily on the Nordic region. It could be potentially beneficial to research further the business opportunities and benefits for countries like Germany and the Netherlands, where the continent’s biggest ports are located.

8.3 Learning reflections

Throughout this thesis, the writer aimed to look into various aspects of international trade and shipping, which proved to be challenging given that the route researched still needs to be fully

utilized. The focus was put on highly credible academic sources and experienced professionals during the research phase.

Additionally, combining the writing process and weekly work hours caused a certain degree of challenge which prevented the author from interviewing more Supply Chain professionals. Specifically, it would be highly beneficial from an academic perspective to gain insights from the Chinese shipping companies' representatives, the NSR administration, ice-breaker industry experts, and government officials. Nevertheless, the project was well-committed to and interested in and could potentially spark ideas for further research and investigation.

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Appendices

Appendix 1. Interviews and insights taken from them

Question 1: What are the challenges that prevent international commercial shipping along the NSR?

Interview A. Professor of Supply Chain Management from a Finnish University of Applied Sciences	Interview B. Senior Director of Corporate Communications from Hapag-Lloyd	Interview C. Head of an international logistics company
• Great political and societal pressure on the shipping line operators in view of Russia's recent political activity and sanctions imposed on it. Reputation for May is more important than time savings. • A lack of strong commitment from shipping companies for the NSR at the given stage of development. Almost none of them will want to pioneer the route.	• A lack and even absence of significant international ports along the NSR makes it useless from a commercial containership perspective. • Safety and security issues concern the company, as it does not want to risk the lives of its seamen. • Russia is no longer served by the company making the route prohibitable for now. • Increased insurance is most likely not worth the risk associated with it. • Low demand for the route overall in the near future.	• Much higher insurance rates are associated with shipping in the Arctic. This is something many shippers, including the leaders of the market, will unlikely want to be involved in. • The high risk of navigating in the unknown environment puts the whole idea of NSR shipping under question for international shippers who are only experienced with the Suez Canal operations.

Question 2: Who will be the main drivers/key players in the NSR development?

Interview A. Professor of Supply Chain Management from a Finnish University of Applied Sciences	Interview B. Senior Director of Corporate Communications from Hapag-Lloyd	Interview C. Head of an international logistics company
• The initiative of the development lies mainly on the shoulders of big shipping companies. They are significant enough, especially together, to leverage the progress of the NSR. • Major European ports can have their role in the process as they increase the capacity and upgrade the facilities to accommodate Arctic traffic	• The Russian Government will be trying to popularize the route and try to increase its use with the help of Chinese operators in the nearest future. • The crude oil industry and its supply chain will most likely be the main shippers on the route due to the resource base that is located in the region.	• Russia will remain the main driver since the route almost fully lies within their waters. Ultimately, it is also in their financial interest to attract international traffic to the region.

Question 3: How do you perceive the financial benefits that the NSR can bring in the future?

Interview A. Professor of Supply Chain Management from a Finnish University of Applied Sciences	Interview B. Senior Director of Corporate Communications from Hapag-Lloyd	Interview C. Head of an international logistics company
• The conceptual model might look good on paper but does not actually guarantee real financial benefits, especially when speculating decades in the future.	• In terms of importance in the container shipping industry, speed is much inferior to other factors. The most crucial thing is to “touch the right ports” in order to make use of	• The real question is whether the rates, fees, and prices that are discussed and taken as baselines in the simulation models and research can be achieved in the future whenever the NSR is

• It is also important to remember that the shipping price and profit/loss do not rely solely on the speed of delivery. There is much more detail to the calculations and aspects, many of which the NSR is lacking.	economies of scale and local demand. • The proposed mixed model looks attractive for future logistical operations and could be explored further when the NSR overcomes its main barriers.	ready. Most of it is speculation which should be taken with a pinch of salt.

Question 4: How do you view the environmental concerns related to the NSR shipping?

Interview A. Professor of Supply Chain Management from a Finnish University of Applied Sciences	Interview B. Senior Director of Corporate Communications from Hapag-Lloyd	Interview C. Head of an international logistics company
• As far as business is concerned, the common idea is how customers and consumers perceive these types of shipping operations. As long they approve the impact, shipping line operators can carry on their core business.	• The environmental impact that can potentially be triggered by the NSR has not been researched yet within the industry. • One of the practices that is currently being implemented to decrease the carbon footprint is slowing the ships down. This, in return, also decreases the fuel consumption. In some cases, containerships with low-priority cargo are routed around Cape Horn of South Africa.	• With the current rate of technological development, it could be predicted that the alternative types of fuel will make the NSR align with the climate regulation agenda. • Most of the ecological concerns will likely be “thrown” on big companies and their sustainability departments.

Question 5: What is the role of the Nordics in the NSR development?

Interview A. Professor of Supply Chain Management from a Finnish University of Applied Sciences	Interview B. Senior Director of Corporate Communications from Hapag-Lloyd	Interview C. Head of an international logistics company
• The Nordic countries, especially Finland, have no say and are barely involved in the NSR development process. • The integrated Nordic supply chain to adapt to the new reality of Arctic shipping is something that is too big to finance individually. In this case, external support, for example, from the EU, will be required making the project a very long-term commitment.	• No comments due to absence of knowledge of Nordic market and business.	• The Nordic countries, Finland in particular, do not have much leverage and will have to adapt to the market development “on the go” rather than promoting it. • Most likely, the countries will continue to cater to feeder traffic of smaller containerships in the foreseeable future.

Question 5: additional remarks and thoughts

Interview A. Professor of Supply Chain Management from a Finnish University of Applied Sciences	Interview B. Senior Director of Corporate Communications from Hapag-Lloyd	Interview C. Head of an international logistics company
• The concept of Arctic shipping has been present in the Supply Chain Management network for several decades now.	• The overall capacity of the containership fleet is predicted to keep increasing, which does not go hand in hand with the	• Singapore has a significant potential to become Asia’s main containership hub. This, in return, makes the NSR transit longer and

However, as of now, we still see little to zero progress internally and externally on this idea.	operational models suggested for the NSR.	destroys its purpose. International shippers might want to wait for the industry developments in the East first before venturing into the NSR.