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Analysis of development, potential and importance of the Northern Sea Route

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Abstract
Today, almost 80% of cargo is transported by sea. Most of the global maritime shipping operations are performed in the direction East – West, through the southern routes, e.g. Singapore – Suez Canal – Gibraltar – Europe. The total fuel cost is the major concern and the main drawback of these routes. According to the latest statistics and analyses, the price of fuel is growing and such a trend will cause a great impact on the economies of developing countries. For these reasons, new alternative maritime routes, in which the optimisation of transportation in the maritime transport network can be achieved, are to be found. There is a possibility of establishing such routes in the areas of high latitudes where climatological changes and diminishing ice open up entirely new possibilities for shipping and present completely new challenges in the global shipping industry. Through the comparative analysis of the main routes and the SWOT (Strengths, Weaknesses, Opportunities and Threats) method, this paper discusses the advantages, potential and importance, as well as the level of reliability, threats and disadvantages of using the areas of high latitude in maritime transport.

Introduction

Polar waters are areas in which ice conditions pose a threat to ships. Navigation in the Polar Regions is considered to be navigation of higher risk because of the danger of ice. Low temperatures in these areas negatively affect the operation of the devices on board. In addition, sailing in Polar Regions involves special requirements for the ship and seamen. Such requirements include the preparation of the ship for navigation (extra supplies, communication devices for the A4 area, answering to checkpoints, reporting countries that are monitoring the region, engagement of icebreakers, special training for seafarers and so on). The traffic of merchant ships in this area was negligible until recently, and the reason for this lies in the lack of larger ports in this area and in the inability to use certain routes because of the ice. Nautical charts of the polar region are less reliable, relatively low hydrographic survey. The Polar Regions have long been unexploited in economic terms for traffic and were used only for research, military exercises and so on, avoiding the expensive process of reambulation. However, the reliability of nautical charts in the Polar Regions is improving due to increased traffic.

Of all polar waters in the Arctic, the Northwest Passage (NWP) was, in 2007, the first passage with no ice. According to the International Maritime Organisation (IMO) the waters in the Arctic are located north of a line extending from P1 (lat = 58°00.0'N, long = 042°00.0'E) to P2 (lat = 64°37.0'N, long = 035°27.0'W), from P2 by rhumb line to P3 (lat = 67°03.9'N, long = 026°33.4'W), from P3 by rhumb line to Sorkapp, Jan Mayen, from the southern coast of Jan Mayen to the island

Bjørnøya, Svalbard to Kanin Nos, then from Kanin Nos on the northern coast of the Asian continent to the Bering Strait and from the Bering Strait to the west latitude lat = 60°00.0'N to Il'pyrskiy (Russia). Following parallel lat = 60°N to the East including Etolin strait, and from there on the north coast of North America to lat = 60°00.0'N, and then to the East of the P4 (lat = 60°00.0'N, long = 056°37.1'E) to P5 (lat = 058°00.0'N, long = 042°00.0'E) (Galić, Lušić & Pušić, 2013) (Figure 1).

According to the instructions of the IMO, companies are required to prepare their ships and seamen to sail in Arctic waters (Janne, 2015). In the next few years the increasing melting of ice in the Arctic is to be expected due to global warming. Ice cover over Siberia has almost completely disappeared during the summer months (Figure 3). Although, the Arctic Ocean is navigable there are icebergs that are dangerous for navigation. Studies

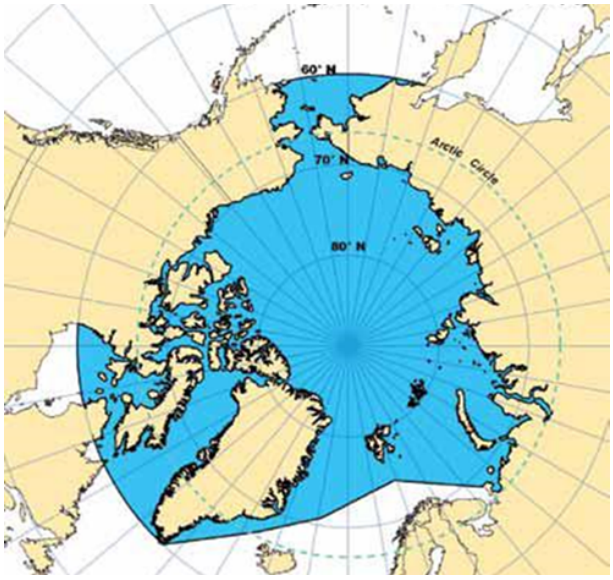

Figure 1. The boundaries of polar waters in the Arctic defined by IMO (Arctis, 2015)

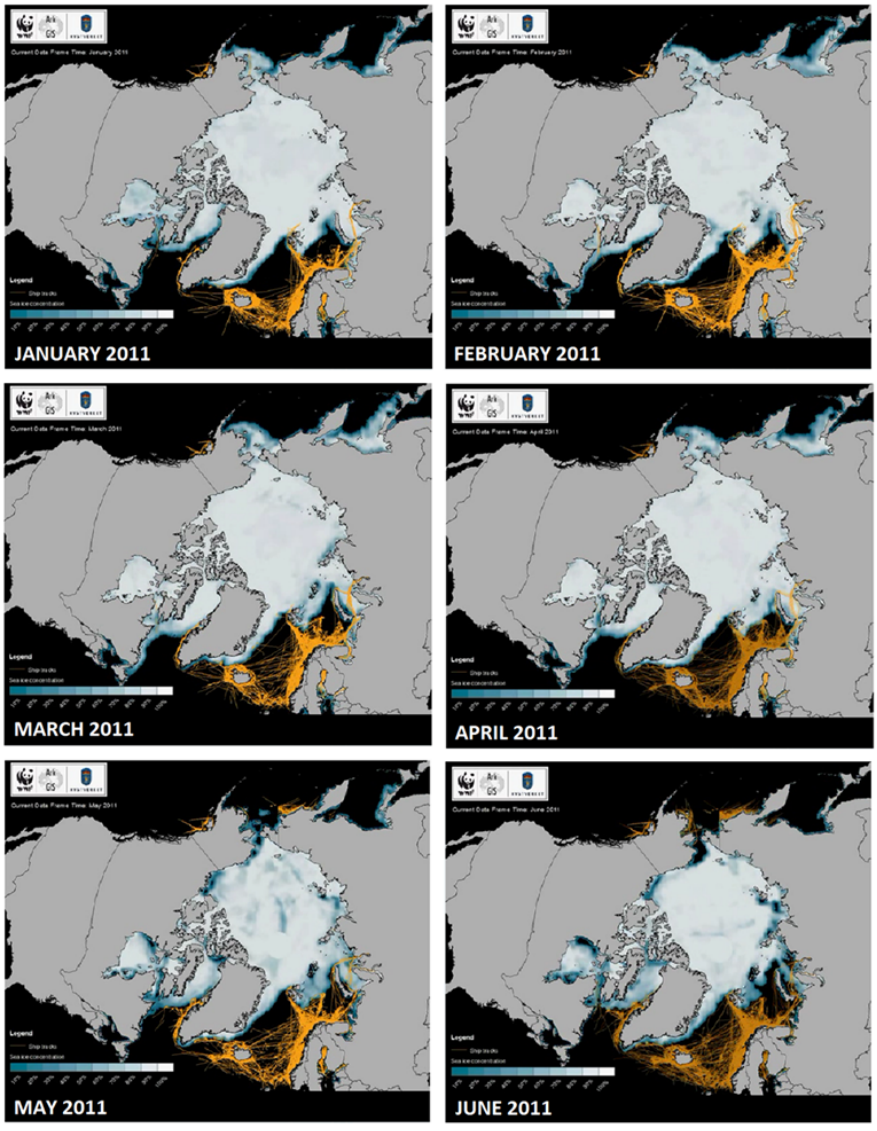

Figure 2. Sea ice concentration and ship traffic density (From January until June 2011) (Kystverket, 2015)

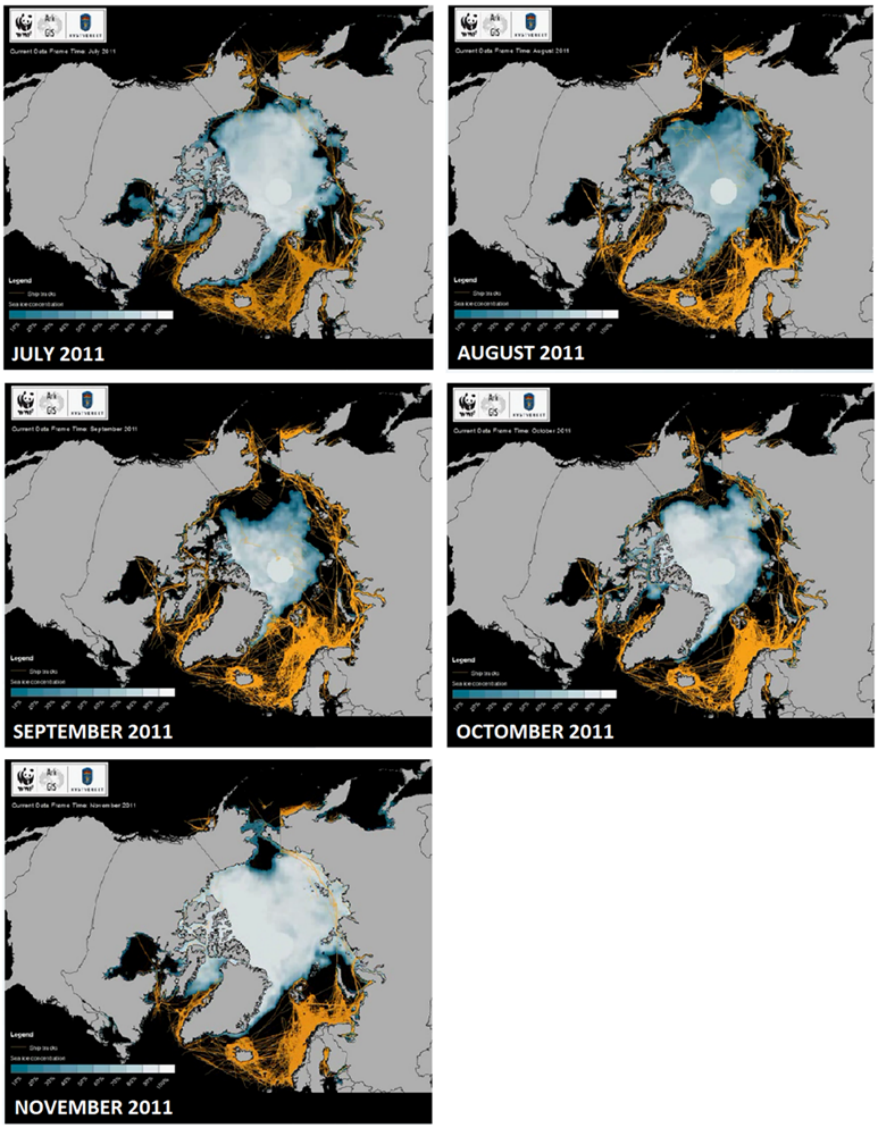

Figure 3. Sea ice concentration and ship traffic density (From July until November 2011) (Kystverket, 2015)

have shown that the fastest melting of the Arctic ice was recorded in mid-September 2012 (Evers, 2013).

These changes allow for even greater exploitation of the Arctic navigation routes. During winter in the Arctic the ice growth was smaller and during summer months in the Arctic the increasing melting of ice was recorded. According to the research conducted, it is expected that the sea ice will continue to collect, mostly along the northern part of the Canadian Archipelago and Greenland, while a significant drop in ice will be reflected in the central and eastern part of the Arctic. Navigation for large vessels through the Northern Sea Route (NSR) took 141 days during summer in the Arctic, which is more than 4.5 months (Figure 2 and 3).

In arctic conditions one-year ice grows up to approximately 1.6 metres. Arctic-type icebreakers can open passages through ice up to 2.3 m thick. In early July, when navigation through the NSR starts, the ice is not pressurised. That means the ice can be broken and easily moved through. In September and October it is possible that the NSR is completely free of ice. In November the areas of the NSR (Laptev Sea and the East Siberian Sea) are covered with a new layer of ice that provides secure pilotage of vessels with icebreaker assistance. Therefore, in the current ice conditions vessels can navigate from July until December (Arctic, 2015a).

If the impact of global warming continues to rise, then the appearance of new routes for ships in the Arctic is to be expected within the next few decades (DNV, 2015). The development of such a situation, with the new routes, would result in higher profits in transport, reducing freight and cheaper goods to be transported to the final destination.

However, it should be noted that one of the main obstacles in navigation for Polar Regions are the floating ice and icebergs, particularly during the

warmer season when the ice starts to melt. In navigation through the Arctic ships would save on time and fuel needed for cargo transportation.

Overview of the maritime shipping and transported cargo on the Northern Sea Route

The NSR is a shipping lane running along the northern coasts of Eurasia from Murmansk to the Bering Strait, connecting the Atlantic and the Pacific oceans. The difference between the Northeast Passage (NEP) and the NSR is that the NEP includes the Northern Sea Route and the Barents Sea.

The 2013 data show that ships transported more than 1,000,000 tons of cargo across the NSR (Humpert, 2014). Given the fact that the Arctic sea ice has been gradually shrinking, thinning and melting over the last few decades, it is expected that the intensity of shipping will increase. In 2013 vessels transported around 1,355,897 tons of cargo, an increase of 54% compared to the year before (Figure 4). Russia expects that shipping will increase by 10 million tons over the next 10 years (Humpert & Raspotnik, 2012).

The NSR remains a shipping lane with a limited number of true transits. Out of a total of 71 vessels, only 30 vessels carried cargo in 2013, while 41 vessels sailed under ballast or remained in Russian waters in 2013. Statistically, the number of cargo ships using the NSR has considerably increased since 2007, when major ice diminishing was detected in the area (Figure 5).

Over the next few years the volume of cargo transported across the NSR could increase by 10 to

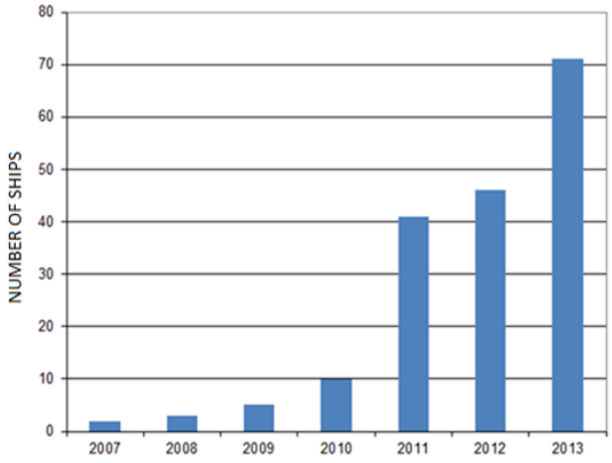

Figure 5. Number of vessels that used the NSR from 2007 to 2013 (Arctic, 2015b)

15% per year (Valdai Discussion Club, 2015). According to the same forecasts, the volume of shipped cargo might become seven times larger over the following five years, amounting to 10 million metric tons. The realisation of these forecasts requires appropriate infrastructure (e.g. sufficient number of available ice-breakers, logistics, efficient tools for addressing marine environment threats, search and rescue service, etc.) which could ensure the safety of navigation and the cost-effectiveness of the route. Climatological research indicates that climate changes may result in a significant increase in shipping through the NSR. If the temperature increases and ice melting at high latitudes continues, it is estimated that around 10% of world exports might be carried through the NSR by 2020. Such a scenario would result in huge

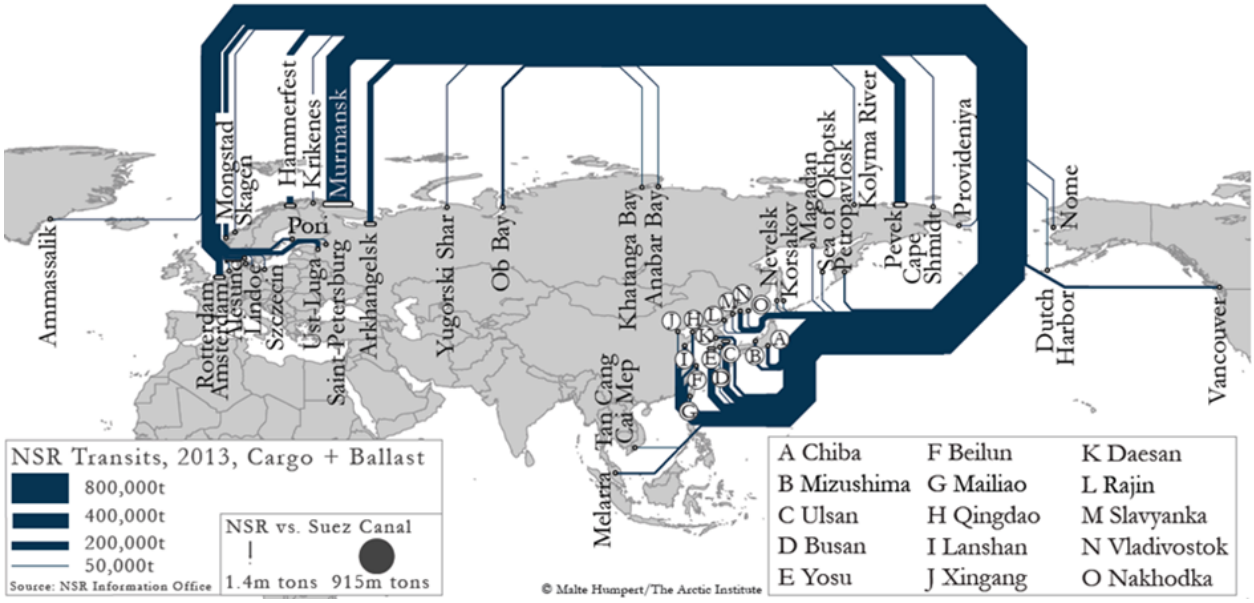

Figure 4. Amount of cargo shipped on NSR in 2013 (The Arctic Institut, 2014)

advantages for the region that has had few benefits from these trends so far.

Statistically, most of the existing shipping has resulted from the export-import operations of Russian ports. It is expected that ice conditions will continue to strongly affect maritime shipping in the area. The limited use of the route presently includes a high rate of ballast voyages. Most of the vessels have less than 20,000 dwt. The development of offshore industries in the Arctic encourages economic activities and the integration of the Arctic and global economies. It is expected that the near future will see an increase in the export of hydrocarbons from Arctic resources, thus resulting in increased shipping along the NSR. Although the Northeast Route is not likely to become the most important shipping lane, this scenario will strongly affect maritime transport running from the West to the East. Establishing the NSR as the major export route depends on a number of essential factors including adverse market conditions, varying levels of ice thickness, lack of available ice-breakers, etc.

Comparative analysis of the northern and southern sea route

The Southern Sea Passage (SSP) is the shipping lane connecting Asia and Europe via Singapore, the Suez Canal and Gibraltar. Theoretically, navigation through Arctic shipping routes enables savings of up to 40%, compared to SSP navigation (Table 1). Most maritime shipping is presently performed via the SSP route, through the Suez Canal (Figure 6).

The trend is affected by a number of factors. One of them is the fact that the NSR is subject to restrictions and limitations regarding the draught and direction of sailing. In 2014 IMO introduced the Polar Code, i.e. a binding international framework to protect vessels and the two Polar Regions – Arctic and Antarctic – from maritime risks. The Code restricts navigation through the Polar Regions. It also brings specific requirements regarding waste management and oil and ballast water management. In addition to environment protection regulations, the Code requires officers to hold special certificates of competence. Officers have to be familiar with the sailing characteristics and procedures in various ice thickness conditions. The NSR is ice-free only during a short part of the year. The ability of a vessel to sail through the route depends on the integrity and strength of her hull, i.e. the hull class. Vessels operating in the area require the assistance of ice-breakers which form convoys. Such a sailing mode causes waiting and costs related to the services provided by ice-breakers, pilots, etc. In order to achieve traffic optimisation of navigation in polar conditions, shipping companies use double acting ships (DAS) and double acting tankers (DAT) that are specifically designed for sailing in light ice conditions and

Table 1. Distance between ports and distance savings when using the NSR

Voyage	via the Suez Canal			via the Northern Sea Route		
	Distance (NM)	Speed (knots)	Voyage duration (days)	Distance (NM)	Speed (knots)	Voyage duration (days)
Busan (S. Korea) – Rotterdam (Netherlands)	11,159	14	33.2	7,432	13	23.8
Chiba (Japan) – Hammerfest (Norway)	12,802	14	38.1	5,844	13	18.7
Chiba (Japan) – Rotterdam (Netherlands)	11,575	14	34.4	7,153	13	22.9
Daesan (S. Korea) – Rotterdam (Netherlands)	11,165	14	33.2	7,744	13	24.8
Quindao (China) – Murmansk (Russia)	12,592	14	37.5	6,425	13	20.6
Voyage	via the Panama Canal			via the Northern Sea Route		
	Distance (NM)	Speed (knots)	Voyage duration (days)	Distance (NM)	Speed (knots)	Voyage duration (days)
Vancouver (Canada) – Poli (Finland)	9,671	14	28.8	7,133	13	22.9

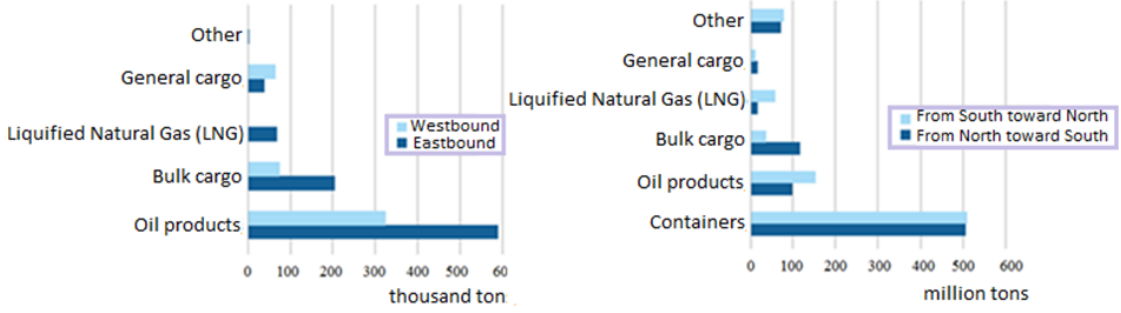

Figure 6. Share of cargo volume shipped through the Northern Sea Route (NSR) and the Southern Sea Route (SSR) through the Suez Canal in 2013 (Arctic, 2015b)

are able to turn around and run astern in hard ice conditions.

Other constraints include a potential decrease in efficiency or even failure of numerous ship components. Moreover, search and rescue operations and oil pollution operations can be complex and costly due to harsh conditions and the remoteness of the area. Adverse weather conditions,

Table 2. Analysis of the logic matrix of the NSR optimisation

	Operation logic	Objectively verifiable indicators of efficiency	Sources and tools of verification	Assumptions
General objectives	Shorter and more efficient connections between world ports	Key efficiency indicators: since the major ice melting on the NSR was recorded, the number of cargo ships has considerably increased along the route	International Maritime Organisation Northern Sea Route Information Office	Over the next few years, the volume of cargo shipped through the NSR might increase by 10 to 15% per year
Specific objectives	Investment in the adequate infrastructure, thus enabling the safety of navigation and economic efficiency of the route	Increase in the export of hydrocarbons from Arctic resources, resulting in increased shipping along the Northeast Route	International Maritime Organisation Northern Sea Route Information Office	Ice melting will not result in the Northeast Route becoming the most important shipping lane, but will strongly affect maritime transport running from the West to the East
Expected outcomes	If the climate changes continue, the volume of cargo shipped through the NSR might increase by 10 to 15% per year over the next several years	Climatological changes, establishment of new shipping lanes, increase in traffic through the Northern Sea Route	International Maritime Organisation Northern Sea Route Information Office	According to long-term forecasts, if the accelerated ice melting at the Arctic continues, the waters in the area might become real navigation routes
Activities	Key activities in the NSR area include climate changes and building adequate infrastructure	Political and financial resources	International Maritime Organisation Northern Sea Route Information Office	The major prerequisite is the continuation of climate changes. The NSR could be operable over 141 days, from early July to mid-November

Table 3. SWOT analysis of the Northern Sea Route

Strengths	Weaknesses	Opportunities	Threats
Distance saving on the NSR amounts up to 40% compared to the SSR via the Suez Canal	The Northern Sea Route is subject to restrictions and limitations regarding the draught and the sailing direction. Additional costs include training of the crew for sailing in the area	Larger profit due to reduced distance and possibility of increased traffic over the year	Drifting icebergs and adverse weather conditions. Lower reliability of the polar region sea charts due to insufficient geodetic measurements. Low temperatures may cause malfunctions and failures of the ship components
Better shipping efficiency, resulting from distance saving and shorter voyages, i.e. vessels performing more transits from one port to another, eventually ensuring higher profit	The NSR is not operable year-round; it is used only over a few months per year	Opportunity of establishing new shipping lanes in the Arctic	Recession in economy. Adverse market conditions
Some parts of the NSR are ice-free during summer months	The predominantly one-way traffic results in a number of vessels travelling unladen and under ballast, thus reducing profits	Opportunity of the Northeast Route to function as a true shipping lane	According to long-term forecasts, if the accelerated ice melting at the Arctic continues, the waters in the area might become real navigation routes
Assistance of ice-breakers in difficult ice conditions along the Northern Sea Route	Poor infrastructure and technical support. Ice navigation requires special certificates of competence. Officers have to be familiar with the ships' behaviour, sailing characteristics and sailing procedures in various ice level conditions	Opportunity to build adequate infrastructure and good technical support	Sailing in the NSR area includes waiting and costs of assistance of ice-breakers, pilots, etc.
Export of large amounts of hydrocarbons from Arctic resources, especially from Russia	Economic recession. Adverse market conditions	It is necessary to make huge investments into adequate infrastructure	Economic recession. Adverse market conditions

relative reliability of the polar region sea charts, communication system disorders and the impact of harsh conditions on other navigation equipment also represent constraints in Northern Sea Route navigation.

Analysis of the logic matrix and the SWOT analysis of the Northern Sea Route

On the basis of detailed statistical data, a logic matrix analysis (Table 2) and a SWOT analysis (Table 3) of the NSR have been carried out. The data processing and the analyses indicate that:

- Lack of reliable weather forecasting, drifting icebergs and adverse weather conditions affect the safety of navigation on the NSR.
- NSR is navigable only during summer months.
- Ice conditions will continue to affect maritime traffic. The high level of year-round ice area remains unsuitable for container shipping.
- Presently, NSR does not function as a shipping lane that is competitive with the South Sea Passage. The predominantly one-way traffic results in a number of vessels travelling unladen and under ballast, which is not sufficiently cost-efficient.
- Navigation on the NSR depends on three major factors: predictability, punctuality and economy.

Conclusions

Saving in distance achieved by using the NSR can amount up to 40% as compared with the Southern Sea Passage via the Suez Canal. Shorter voyages ensure higher shipping efficiency, as a vessel is able to perform more voyages from one port to another, consequently making more profit.

In order to establish the NSR as a major competitor to other shipping lanes, it is necessary to carry out crucial activities that would ensure better results regarding the volume of cargo shipped through the NSR. It is necessary to make considerable investments into appropriate infrastructure and ensure adequate numbers of available ice-breakers, full technical support, efficient tools for addressing marine environment pollution, and efficient search and rescue services. It can be concluded that the NSR presently remains a shipping lane with a limited number of true transits. The navigation along the route depends on three crucial factors: predictability, punctuality and economy. If certain constraints regarding adverse market conditions, various levels of ice thickness, technical services and available ice-breakers are resolved or mitigated, it could be possible to establish the Northeast Route as a major export route.

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