Research Article

Northern Sea Route (NSR) as a Major Transport Route: Opportunities and Challenges

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Abstract: Northern Sea Route (NSR) is focused on because it might bring a higher efficiency of logistics between Europe and Asia. However, until the route becomes a major transport route, there will be challenges. The purpose of this paper is to discuss both opportunities and challenges by focusing on different elements: technical feasibility, economic feasibility, and geopolitical/policy aspects. Regarding the technical feasibility, discussion starts with the monitoring of actual vessel movements. By analyzing transit time/reliability as well as navigability, current service levels and technical challenges are examined. Regarding the economic feasibility, we will mainly focus on the possible advantages of NSR for supply chain efficiency of shippers. Some conceptual ideas are proposed. Finally, the geopolitical and policy aspects are also critical. In this regard, recent policies including the Polar Silk Road are reviewed, and future prospects are examined.

Keywords: Arctic Shipping, NSR, Supply Chains, Ice Navigation, Geopolitics.

1. INTRODUCTION

Northern Sea Route (NSR) is focused on because it might bring a higher efficiency of logistics between Europe and Asia. While positive sides are pointed out, there will be challenges until the route becomes a major transport route. The purpose of this paper is to discuss both opportunities and challenges of NSR shipping, so that feasibility can be considered objectively focusing on technical feasibility, economic feasibility, and geopolitical/policy aspects.

The discussion starts with the technical feasibility. The existence of sea-ice is affecting on shipping, causing low service levels and concerns by the users, i.e. carriers and shippers. Recently the monitoring of actual vessel movements on NSR has become possible by Satellite-based Automatic Identification System (AIS). By analyzing transit time/reliability as well as navigability, current service levels and technical challenges are examined.

Secondly the economic feasibility is considered. Adequate service levels are vital so that NSR is more commonly utilized and the profitability of shipping companies is secured. So far, discussions on feasibility have been mainly from carriers’ point of view. However, due to the shorter transit times, it is worth examining how NSR will bring benefits to shippers’ Supply Chain Management (SCM). Some conceptual ideas are shown as well as limitations.

Thirdly, the geopolitical and policy aspects are also critical. It is inevitable that choke

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points in maritime shipping are affected by political interventions, if we look at the history of Panama/Suez Canal. In this regard, recent policy documents including the NSR administration of Russia and the Polar Silk Road of China are introduced. This is followed by an examination of future prospects based on recent articles obtained from news sources.

Finally, conclusions and policy implications are given as well as future works.

2. LITERATURE REVIEW

Regarding the technical feasibility several papers can be seen on the navigability of NSR. Khon et al. (2010) simulate a long-term trend of sea-ice extent and its effects on shipping periods of NSR. Tseng and Pilcher (2017) conduct an interview-based survey on the feasibility of NSR, covering issues of navigation technology and ship building. Kiiski et al. (2018) assess the capability of icebreakers for different growth scenarios of traffic on NSR. Fedi et al. (2018) evaluate the effectiveness of risk mitigation of shipping activities expected by Polar Code of International Maritime Organization (IMO), and conclude that unsolved issues still remain. Fu et al. (2018) try to identify risk influencing factors of Arctic shipping, focusing on four major elements: the human factor, the ship factor, the environmental factor, and the management factor.

For the economic feasibility, a number of studies are conducted in order to verify cost reductions of shipping via NSR. Xu et al. (2011) work on container shipping with a concept of slow steaming, and Furuichi and Otsuka (2015) propose a common platform for calculation of shipping costs via NSR. Pruyn (2016) assesses the viability of NSR targeting on dry bulk shipping utilizing maritime macro to micro-economic model so that demand and supply of ice-class vessels can be considered. Otsuka et al. (2016) estimate shipping costs targeting on different types of cargoes including containers, liquid bulk, and completed cars. Furuichi and Otsuka (2018) propose a quick delivery service under the combination of NSR and Suez Canal route (NSR/SCR combined service) and verify its feasibility. Xu et al. (2018) also work on the NSR/SCR combined service, but propose a new dynamic approach where the changing sea-ice extent can be considered. Solakivi et al. (2017) estimate the prices of ice-class container vessels of which result can be utilized for the cost analysis of NSR. Shibasaki et al. (2018) analyze possible changes of LNG trading patterns and routes, caused by the utilization of NSR or the expansion of Panama Canal.

A study by Lee and Song (2014) is unique in that they conduct a SP survey to potential users (forwarders and logistics companies) in order to estimate route choices of NSR. Also, Zhu et al. (2018) estimate the future shares of NSR as well as the environmental cost reduction. Zhang (2016) assess the attractiveness of shipping via NSR for shipping companies, under the utilization of actual transit records. Lee and Hwang (2015) examine specific uses of NSR from a Korean perspective proposing two business models: carriage of wood pellets from Russia and introduction of cruising hub at Korean ports.

Other studies deal with the feasibility of NSR from more comprehensive viewpoints. Farré et al. (2014) indicate that while economic expectations exist, the feasibility of NSR is overstated given the technical and political challenges. Lee and Kim (2015) assess the difficulties of shipping operations of NSR from two aspects: economic sides and external policy sides. Smirnov (2015) introduces economic prospects regarding NSR, and points out that the international cooperation with Russia is necessary to upgrade infrastructure for stable uses of NSR. Otsuka et al. (2017) review the history, the current navigation status, and the challenges in terms of shipping costs and navigability. Yamaguchi and Otsuka (2017) indicate the necessity of integrated researches among a wide range of disciplines, in order to make the
use of NSR more feasible.

While the papers above already overview key points for the feasibility of NSR, this paper is aiming at providing updated and concrete information and insights from different viewpoints, such as in-depth analysis of navigability by the satellite based AIS, a conceptual examination from the viewpoint of shippers’ supply chain operations, and analysis based on the updated national policies and information.

3. ARCTIC SHIPPING: A BRIEF REVIEW

By the shipping in the Arctic, nautical distances between Pacific Ocean and Atlantic Ocean can be shortened. There are three routes in the Arctic shipping: the Northwest Passage, the Northeast Passage, and the Central Passage (Figure 1). NSR is defined by the Russian Government on a certain sea area within the Northeast Passage.

Historically the Northeast Passage has been utilized for domestic shipping of Russia. In the era of Cold War, some facilities and ice breakers were constructed, however, the route was not opened to foreign flag vessels. After the end of the Cold War, the route was opened as an international shipping route. In 1989, the first voyage was conducted by a Germany company; it chartered a Russian cargo vessel which sailed from Hamburg to Osaka (Kjerstad, 2011). This fact implies that Russia has already accumulated the knowledge of the Arctic shipping.

The Russian government intervenes to the passage of NSR by the introduction of the permission system. The Russian government sets a condition where shipping activities are permitted, based on sailing seasons or sea ice conditions. Under certain conditions, escort by icebreakers operated by the Russian state company and/or introduction of ice-class vessels are necessary to obtain the permission. Russia recognizes that such intervention can be rationalized under the United Nations Convention on the Law of the Sea (UNCLOS), the article 234. The article gives a right to coastal states which own EEZs covered with sea-ice, to set out rules for navigation. The purpose of this legislation is to remove obstacles of shipping and to prevent sea pollutions by accidents and other causes. Russia complies with this convention.

![Figure 1. Routes of the arctic shipping](image)

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4. UTILIZATION OF AIS DATA

As the Arctic is a remote area, it is not necessarily easy to monitor actual vessel movements. For this reason, in the following sections satellite AIS data is utilized. AIS is originally introduced by IMO. In order to prevent ship collisions, vessels under certain conditions are obliged to send AIS messages, including vessel name, location, vessel speed, etc. in certain time intervals. Currently, AIS data can be captured by satellites (Figure 2). Japan Aerospace Exploration Agency (JAXA) has been operating two satellites, and in this study the AIS data is provided by them. Figure 3 is the mapping of vessel movements in September 2015. Whole of the Arctic sea is covered and vessel movements are captured in detail. It should be noted that other than JAXA, some private companies are also selling such data.

![Figure 2. Image of vessel monitoring by satellite AIS](image)

Figure 3. Vessel movements captured by JAXA (September 2015)

5. SAILING STATISTICS

Figure 4 shows the recent statistics created from satellite AIS data. In the figure, number of
sails which passed the whole section of NSR (by the Russian definition) are extracted and counted. Compared with 2015, the number in 2016 increased. This is due to the increase of heavy lift vessels for the Yamal LNG construction project. In the project, modules of LNG plants were constructed in Asia and Europe which were carried by sea to Sabetta Port, the main port of the Yamal region, because of the very tough working environment of the Yamal region. For this reason, a number of heavy lift vessels sailed to/from Yamal region. Also, bulk carriers were utilized for the construction as well. The new economic activity in the Arctic region increased sails. After the construction was completed, shipment of LNG started in December 2017 to Europe and Asia. The transport of LNG is being conducted under the utilization of icebreaking LNG carriers, which were newly developed for this project. In 2016, the number of transit sails (defined as sails where ships did not call at any ports in NSR) was 19. Yet the number increased to 29 in 2017. Table 1 shows detailed vessel types of the transit sails of 2017. The majority of such transit sails were done by general cargo vessels which have capacities to carry containers. Many of the sails were conducted by COSCO, the Chinese leading shipping company. It organized a seminar in Japan, presenting that they will strengthen marketing activities in order to attract shippers to use NSR as a new route. Also, the company admitted that their effort was a part of the Belt and Road Initiative (BRI). If their marketing approach is successful, more cargo might be carried by general cargo vessels, and more variety of cargo such as containers might be also treated. However, it also must be recognized that number of NSR transit sails is far less than that of the current Suez Canal route.

![Figure 4. Number of sails on NSR](image)

Table 1. Vessel types of transit sails in 2017/2016

<table>
<thead>
<tr>
<th>Vessel Types</th>
<th>No. of Transit (2017)</th>
<th>Share</th>
<th>No. of Transit (2016)</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Cargo</td>
<td>15</td>
<td>51.7%</td>
<td>8</td>
<td>42.1%</td>
</tr>
<tr>
<td>Bulker</td>
<td>1</td>
<td>3.4%</td>
<td>2</td>
<td>10.5%</td>
</tr>
<tr>
<td>Tanker</td>
<td>5</td>
<td>17.2%</td>
<td>3</td>
<td>15.8%</td>
</tr>
<tr>
<td>Passenger/Cruise</td>
<td>3</td>
<td>10.3%</td>
<td>2</td>
<td>10.5%</td>
</tr>
<tr>
<td>Heavy Lift</td>
<td>2</td>
<td>6.9%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
<td>10.3%</td>
<td>4</td>
<td>21.1%</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>100.0%</td>
<td>19</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

1 Source: Abe et al. (2018)
6. SAILING IN SEA-ICE: ACTUAL MOVEMENT AND CHALLENGES

6.1 Actual Vessel Movement in Sea-Ice

Figure 5 and 6 show satellite images of the vessel movements by AIS and the ice coverage areas, elaborated by authors. The data for both of them were originally captured by the satellites operated by JAXA. Here ice concentration is an index which shows to what extent sea is covered with ice. 100% shows that the water is totally covered. Normally, the shipping in NSR starts in July (Figure 5: Left), however, most of the routes are covered by sea-ice, implying that sails are highly affected and restricted by sea-ice. In August (Figure 5: Right), sea-ice decreased, yet some sea-ice remained on shipping routes.

![Figure 5. Sea ice location and vessel locations (left: July 2016, right: August 2016)](image)

Figure 6 (Left) is the image of September in 2016. In the image, sea-ice disappeared from the sailing routes. The area of such open water was the largest in September in the year. In October, sea-ice started to develop again, and in November (Figure 6: Right) shipping routes were entirely covered with sea-ice. Even under such a condition, several sails were observed.

![Figure 6. Sea ice location and vessel locations (left: Sep. 2016, right: Nov. 2016)](image)
6.2 Sailing Season and Reliability

Figure 7 is a diagram of NSR shipping in 2016. The horizontal axis shows date (in 2016), and the vertical shows East Longitude. In the figure, all the AIS data are plotted for the vessels which passed the whole section of NSR. Sea-ice area is hatched for a reference. The slopes of lines show vessel speeds. According to the figures, more lines are seen in September and October than other months, showing that more vessels existed. To the contrary, in earlier seasons when sea-ice remained, less sailings were observed. In addition, there are some sections within sea-ice where vessel movements are very slow, taking 2-3 days to pass (shown in dotted circles). Abe et al. (2018) conducted detailed analysis on such cases by the utilization of commercial AIS data. The study shows that there are two reasons for such delays: special escort practice by icebreakers due to the tough ice conditions or waiting time

Source: Abe et al. (2018)

Figure 7. Diagram of NSR shipping of 2016 (top: July-August, bottom: Sept.-Oct.)

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for cargo vessels to meet with icebreakers.

According to an interview to a manager who conducted actual shipping activities in NSR, careful preparation is necessary before starting sails, such as the collection of the most recent sea-ice condition. Yet there are some cases where cargo vessels could not move by the unexpected sea-ice conditions. In such cases vessels do not face serious risks, however, it takes a couple of days for icebreakers to rescue vessels. More accurate information will contribute to prevent such situations. Changeable weather conditions can be another risk. Waseda et al. (2018) indicate that the decrease of ice area in the Arctic will bring the greater possibility of encountering large storms.

Figure 8 is also a diagram, yet it focuses on a particular section (between 80 to 180 degrees of East Longitude) where shipping activities can be affected by sea-ice, in order to observe transit time and reliability. Only westbound sails are analyzed. Overall, lead-times fluctuate ranging from 6 days to 16 days, however, the majority of sails were completed within 6 days. In some cases, there are 3 days delay. Delays can occur in July and August in the sea-ice. Such delays are due to the time to pass very difficult sea-ice sections and slow sailing speeds. It must be noted that as sea-ice conditions might be different depending on years, further monitoring and analysis will be necessary.

![Figure 8](image_url)

**Figure 8. Analysis on reliability of transit-time (between 80 to 180 degrees)**

### 6.3 Sailing Season and Sea-Ice Condition

Figure 9-11 compare sea-ice locations of 2016 and 2017. In the early seasons (1st of July: Figure 9), sea ice remained both in 2016 and 2017, yet locations are different. As is mentioned above, some delays were observed in 2016.

In the summer seasons (15th of September: Figure 10), the sea-ice disappeared from the sailing routes both in 2016 and 2017, while less sea-ice is observed in 2016 than 2017. In the latest season (in November: Figure 11), sea-ice developed in different areas of the Arctic in 2016 and 2017.

As is mentioned above, reliability can be undermined by the sea-ice, causing 2-3 days delay. Therefore, sea-ice conditions at early seasons and late seasons must be monitored continuously and carefully.
6.4 Sailing in Sea-Ice: Technical Feasibility

6.4.1 Transit time and reliability

With regard to the transit time, the following calculation is possible. Table 2 shows the distance from Asia (Yokohama) to Europe (Hamburg). The route is divided into three sections: 1) Asia-NSR section, 2) NSR section, and 3) NSR-Europe section. As the NSR section is affected by the sea-ice, the average speed is set as 11 knots, according to the actual speeds by AIS data. For other two sections, the speeds are set as 18 knots as in these sections there is no concern of sea-ice. Table 2 is the result of an estimation; the total lead-time is about 18 days. By the route via Suez Canal, at least 33 days (without port calls) are required.
(distance is about 11,000 miles) by container vessels. Considering 3 days delays in Figure 8, the transit time via NSR can be assumed as around 21 days. It could be said that faster transit time is possible by the utilization of NSR. However, in the very early seasons (July in particular), longer lead-times are also possible although such cases are not very common.

### 6.4.2 Sailing season

On the other hand, it must be indicated that there is a limitation of sailing season; from July to October. If sea-ice areas become less, the sailing season can be longer.

### 6.4.3 Safety

Safety is the basis for reliable services. However, it is indicated that systems for safe navigation are not necessarily adequate in NSR. For instance, Japan Association of Maritime Safety (2016) points out that navigation charts were developed in 1990s and still some of them are being upgraded. According to an interview to a shipping company, charts are not reliable in the East Siberian Sea.

In addition, according to the information by Centre for High North Logistics (CHNL), ports along NSR tend be small, indicating that there are not enough port capacities as refuge ports for large vessels. In terms of the search and rescue activity, there are three bases (Dikson, Pevek, and Tiksi) and icebreakers will be utilized for such activities. However, given the limited number of the icebreakers, there would be concerns as to whether or not the search and rescue services are provided in a timely manner. For the safety navigation under the existence of sea-ice, another significant point is reliable information. Vessels need to avoid risky areas, however, sea-ice conditions are changeable. Reliable and timely information of sea-ice is of great significance.

### 6.5.4 Sustainability

Recently concerns for the sustainability in the Arctic are arising, given the increase of shipping activities. Already Polar Code of IMO is in effect, however, further considerations and regulations are proposed, such as the introduction of marine protected areas, the considerations for invasive species, the implementation of environmental monitoring, and the van of uses and carriages of heavy fuel oil (Stephen, 2018).

### 6.6 Technical Feasibility for Major Shipping Route

As is stated above, shipping via NSR is already commercialized. However, NSR is not a major shipping route between Europe and Asia, if the transit record is referred to. Shipping routes via NSR can bring benefits: shorter transport distances and transit times between Europe and Asia. Thus, the following challenges need to be overcome, so that the potential of NSR is cultivated further.
Firstly, improvements are expected in navigability of vessels for longer sailing season. Secondly, infrastructure and systems for safe vessel operation need to be strengthened to mitigate safety concerns by users. They include the upgrading of charts, the development of ports for refuge, and the strengthening of search and rescue systems. Also, information is another significant factor. For safer and more reliable vessel operations, provision of updated information of the changeable sea-ice condition will be beneficial.

Finally, the environmental protection has been recognized a challenge as more economic activities are expected in the region.

7. ECONOMIC FEASIBILITY

7.1 Point of View for Economic Feasibility

In order to examine the economic feasibility, two aspects must be focused upon: profitability of shipping companies, and demand by shippers. However, at this moment it is difficult to examine the former, due to the lack of information. Regarding the Yamal LNG project, it is indicated that a certain level of profitability can be secured by carriage of LNG via NSR: MOL will gain ordinary income of 50 billion JPY in 20 years (Nihon Keizai Shinbun, 2017). This is because the cargo demand base is already secured in a long-term.

On the other hand, for shipping activities between Europe/Asia, the actual cargo demand is still limited. If cargos via the current Suez Canal route are shifted to NSR, or innovative services via NSR are developed, there will be a possibility that NSR becomes a major route. In this section prospects for the increase of the cargo between Europe and Asia via NSR are examined from shippers’ point of view.

7.2 Service Levels for Shippers

Currently shorter transit time can be provided, however, sailing season is limited.

As to the shipping costs, we can refer to the previous works such as Furuichi and Otsuka (2015), Pruyn (2016), and Furuichi and Otsuka (2018). In general, the following costs are considered: escort fees, costs for deployment of ice-class vessels, costs to hire ice pilots, and higher insurance fees. On the other hand, NSR does not necessity the charges for passing Suez Canal, and lower fuel costs are expected due to the shorter sailing distances.

Otsuka et al. (2016) estimate shipping costs via NSR and compares them with those of the Suez Canal route, targeting on different types of cargo (liquid bulk, completed cars, and containers). Although it depends on the sailing seasons, the tendency of lower shipping costs is confirmed for bulk shipping. On the other hand, in case of container shipping, very large vessels (8,000TEUs+) are commonly deployed in the Suez Canal route to seek for economies of scale. Table 3 shows examples of the cost comparisons. Costs via NSR tend to be higher than those via Suez Canal. In the study, transit time for one loop (Asia-Europe-Asia) is set as 49 days, thus one way is set as 25 days.

The existing works imply that cost advantages are not always guaranteed for NSR: what is certain is that shorter transit time can be provided. Therefore, the focus is how the advantage of such shorter transit time can be utilized.

7.3 Possible Scenario for the Use of NSR

From shippers’ point of view, Christopher and Towill (1998) provide a basic but significant
insight on two types of supply chain operations. One is lean supply chains of which objective is cost reduction, while the other is agile supply chains of which purpose is to react to rapidly changing customers’ demand.

In the lean supply chains, reliability is the most significant service factor. At the same time, lead-time reductions are also required. Firms conduct demand forecasts of future sales of products, and if the accuracies of the forecasts are not good, this leads to either shortage of goods or excess inventories, causing higher supply chain costs. Shorter lead-times via NSR can improve the accuracy of demand forecasts.

On the other hand, it must be indicated that the restriction of sailing seasons of NSR is a serious disadvantage. The priority of the service attribute is reliability and stability throughout the years. Changes in shipping routes or transit times will cause additional costs; this is against the concept of the lean production.

In the agile supply chains, the purpose is to react to the changing customers’ demands. For instance, in the apparel or fashion industry, quick operations are required for procurement, production, and distribution. The values of finished products decrease rapidly. Chen and Notteboom (2014) conduct a case study on sport shoes. The sales value decreases 1%/week. Shorter transit times by 1-2 week will bring profits. Moreover in the case of agile supply chains, there can be cases where year-round services are not required; if the seasonality of customers demands match with the sailing seasons of NSR.

The transport in emergency situations is another usage of NSR shipping. There have been a number of papers which touch upon the use of air transport in emergency situations (for instance, Kawasaki, 2014). Unexpected changes of customers’ demands cannot be avoided, and in such cases faster transport is one option to cope with them. Shorter lead-times can bring flexibilities for supply chain operations. According to a shipping company which involved in the shipping of NSR, they once carried an element for a construction. Because of a sudden change of schedule of the construction, the shipper chose to use NSR as an emergency transport route. Other possible cases will include carriage of repair parts or machineries or electronic appliances.

### 7.4 Challenges regarding Economic Feasibility

In this section the possible uses of NSR have been examined, focusing on shippers’ point of view. In the short-term where NSR can be utilized only in summer, the shipping via NSR will be a “niche market” of transport services between Asia and Europe. The restriction of the sailing seasons could be a disadvantage for firms which are managing lean supply chains. In addition, still it is difficult to foresee the exact sailing seasons in a year, due to the changeable sea-ice conditions. This makes it more difficult for shippers to make decisions on shipping.
routes.

In the long-term, where the year-round service is offered, NSR might become a major shipping route, contributing to higher profitability.

For both cases, a common significant point is the service availability. At this moment, only one shipping company shows an intention to provide semi-regular services via NSR by deploying general cargo vessels, however, service frequencies are not high. Furthermore, gateway ports at both ends (Asia and Europe) are not clearly selected and mentioned, making it difficult for shippers to expect concrete service levels and costs. In addition, it can not be denied that shippers care about the administration system of Russia, in terms of political stability.

It is worth adding that Maersk, a major container shipping company, conducted a trial on NSR in September 2018. They sent a 3,600 TEU ice-class container vessels through the Arctic. However, this was a “one-off trial” and the company does not see NSR as a commercial alternative to the current shipping routes (The independent, 2018).

8. FEASIBILITY FROM GEOPOLITICAL AND POLICY PERSPECTIVES

Currently NSR is under the administration system of Russia. In addition, recently the aspect of geopolitics tends to be focused on regarding the Arctic shipping. This is highlighted by the recent the BRI of China; the use of the Arctic is in the scope. It must be recognized that such geopolitical and policy aspects will affect availability and service levels of NSR to some extent, as well as on attractiveness to the users. In this section, the recent policy trends are reviewed for Russia, China, and Japan.

8.1 Russia

It can be said that the nature of interventions by Russia has two aspects; regulation aspects and business aspects. The former is represented by the fact that Russia introduced the administrative system on NSR under UNCLOS.

On the other hand, Russian President Putin expects that NSR will be a major sea route, stating that traffic of NSR will increase tenfold, to 80 million tons by 2025 (Nilsen, 2018). In 2017 the statistics was 9.7 million. Currently Russia requires shippers to hire Russian icebreakers to escort under certain navigational conditions. This creates an income from foreign entities. Moreover, by the activation of NSR, the Russian government expects Foreign Direct Investments (FDIs). For instance, the above-mentioned Yamal LNG project received a significant amount of investment from China and France. As the Russian government has an intention to compete with Suez Canal route and to attract more cargo, it can be expected that more competitive services will be provided.

However, the instability of this route also needs to be considered. For instance, at the end of 2017 President Putin suddenly expressed an intention to introduce a new regulation where carriage of certain types of goods and maritime services (including natural resources) are restricted to the vessels of Russian flag. Some exceptions were introduced for parties which have cooperative relations with Russia in the Yamal LNG project. However, it cannot be denied that such unfair and unforeseeable practices create concerns by the users of NSR. Also, it is a truism that Russia has been constructing navy bases in the region, indicating that the Arctic has a strategic significance.
8.2 China

Recently China recognizes NSR as a major shipping route; it has been a common recognition that NSR is part of the BRI. A significant policy formulation is the publication of its first formal Arctic policy in the early 2018 (Government of China, 2018). In the policy, shipping via Arctic is clearly defined as the “Polar Silk Road”. Striking features of the policy are examined as below.

Firstly, it focuses not only the Northeast passage (including NSR) but also the Northwest passage (Canadian side) and the Central route. This implies that all Arctic region is under the scope of the Chinese policy, and that China has an intention to intervene.

Secondly, it clearly points out the issues of freedom of navigation provided in UNCLOS, and that it must be secured for foreign flag vessels. It can be imagined that China tries to indicate that any unfair practices by the Russia cannot be rationalized.

Thirdly, the term “develop” is used for the Polar Silk Road, not the term “use”. This shows their intention to lead the development of infrastructure and navigation systems related to Arctic shipping. In reality, COSCO admitted that their efforts on NSR shipping is one part of the BRI in the seminar held in Tokyo in 2018, although they are an “independent” shipping company from the government. This implies that China tries to develop shipping routes by the utilization of the company.

Lastly, China seeks for the international cooperation for the development of the infrastructure and navigation systems. In fact, a significant amount of investment is necessary for them, and the involvement by other user states such as Japan, Korea, and other countries in Northern Europe can be a favorable situation for China.

Therefore, the basic idea of the policy by China is that the whole of the Arctic (not limited to NSR) should be developed, under international cooperation. If this idea is successfully realized, the Arctic route will become a major shipping route, mitigating potential geopolitical conflicts.

Moreover, in the policy the future cargo volume is not estimated. As is the same as the BRI itself, the basic concept and strategy would matter more than other detailed policy elements such as concrete traffic volumes. The main intention of the policy would be to seek for international cooperation.

8.3 Japan

The Japan’s first comprehensive Arctic policy was decided by the Cabinet in 2015 (Government of Japan, 2015). The policy sets out the basic directions as to how Japan should intervene and utilize the Arctic. Regarding Arctic shipping, the followings are the policy directions.

Firstly, a close cooperation between the public sector and the private sector is mentioned. The basic idea is that the public sector supports the business activities by the private, such as shippers and carriers. Thus, it is also mentioned that the future demands of Arctic shipping by such users need to be carefully examined. As is examined above, NSR can be utilized in various ways in the future, however at this moment only one Japanese shipping company, MOL is doing an actual business in the Arctic as a part of the Yamal LNG project. To what extent the government of Japan can make actions (including spending budget) depends on concrete traffic demands by the private sector. This is a clear contrast with the policy of China.

Secondly, for the purposes of safety and environmental protection, active involvements in the development of international rules are stated. One example is the involvement to the
development of Polar Code of IMO. In order to protect the fragile environment of the Arctic, Japan has a clear intention for various contributions.

Finally, active contributions in the field of technology and science are mentioned. In this regard, Japan has been providing information of sea-ice condition from the satellites which will give significant supports in the navigation of the Arctic. In addition, other technological developments for the safer navigation are encouraged in the policy.

The Japan’s policy is regard as a common direction shared among the parties concerned. As in Japan the accountability to the public (tax payers) is critical in planning and spending budget, therefore this is a necessary process. On the other hand, how to cooperate with other countries is not clearly stated; this seems to be a matter of future policies.

8.4 Geopolitical and Policy Aspect

As long as Russia takes actions toward the business-oriented policies, the administrative services of NSR will be improved. However, this is a matter of politics. In order to prevent adverse situations, an international cooperation is an option.

Beckman et al. (2017) indicate that the infrastructure development along NSR necessities a large amount of budget, and that the potential user countries such as China, Korea, and Japan can consider financial supports for Russia. They raise an example; the case of Singapore-Malacca Strait, where an international cooperation has been successfully conducted under the support of IMO. It is also suggested that similar approach is worth examining. In the case of Singapore-Malacca Strait, Japanese companies have been funding for the necessary infrastructure and the navigation systems as a responsibility of one of the user states.

However, this scenario is not necessarily an easy option. China, Korea, and Japan are not Arctic states: they are not members of the Arctic Council. Another reality of the Arctic is the arising political tensions. Russia is developing military bases, while it is commonly indicated that China has been conducting a variety of efforts including sending a research vessel (for instance, Eiterjord, 2019). The US recently made a statement that interventions to the region by Non-Arctic States are not admitted (Wroughton, 2019). These issues might cause negative effects on the cooperative relations.

In history, conflicts could not be avoided in the cases of significant chokepoints of the world trade, such as Suez Canal or Panama Canal. It must be carefully examined if the history repeats in the case of NSR, or a good solution can be found out.

9. CONCLUSIONS

In this paper, future prospects as to whether or not NSR (or Arctic shipping) can be a major shipping route between Asia and Europe are, focusing on the three aspects: the technical feasibility, the economic feasibility, and the geopolitical/policy aspect. Here are conclusions as well as future policy implications.

Firstly, there are still technical challenges remaining. In order to provide more reliable services and to maintain the safe shipping in the Arctic, infrastructure and navigation systems need to be developed further, including hardware (better capability of ice-class vessels, update of navigation charts, development ports for refuge, etc.) and software (updated sea-ice information, better systems for search and rescue, etc.).

Secondly shorter transit times via NSR can bring various advantages. In the short-term, there is a possibility that a niche market will be created for emergency services or quicker
services to support the agile supply chains. In the longer-term when sea-ice decreases dramatically, shipping via the Arctic might bring a fundamental change not only in shipping, but also in operations of supply chains.

Thirdly, in terms of the geopolitical and policy aspects, there are some uncertain factors. “Power games” in the Arctic might affect the development and use of this region. It is not possible to foresee the future, however, the international cooperation can be an option to mitigate such uncertainty. Development of the above-mentioned infrastructure requires a large amount of budget to which Russia might expect support.

In the future research, the following points would be worth focusing on.

Firstly, innovative uses of NSR can be cultivated further. If this is successful, more cargo volume will be expected in the future. Also, it must be noted that the competition with the land bridge between Asia and Europe (by railway services) needs to be addressed. Another significant factor is the fluctuations of oil price. NSR becomes more attractive when oil (fuel) prices become higher. It is worth examining the relations between oil prices and the number of sails on NSR.

Secondly, a cooperative mechanism to develop the infrastructure and navigation systems need to be examined. A starting point would be to study on development plan(s) of international logistics corridor(s) in the Arctic; a package of infrastructure and other navigation support systems.

Thirdly, objective facts of sea-ice conditions, transit records and shipping reliabilities need to be accumulated and provided to the potential users, so that they can make right decisions on future business operations.

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