Chapter 3

Commercial Perspective of the Northern Sea Route

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1. Definition of the Arctic Circle

The Arctic Circle as typically defined refers to the region north of 66 degrees 33 minutes 39 seconds north latitude: a region that has the polar night during the winter solstice, which occurs when the sun does not rise, and the midnight sun during the summer solstice, occurring when the sun does not set. It may also refer to the geographical classification focusing on vegetation differences or is also occasionally defined as the region where an average monthly temperature dips below 10 to 12°C in the summertime, which is the season of the highest temperatures.

There are eight countries that have territories in the Arctic Circle: Norway, Sweden, Finland, Russia, the U.S., Canada, Greenland and Iceland.

2. Sea ice condition in the Arctic Ocean

Being the scene of evident rapid environmental changes, as best represented in the decreasing amount of sea ice, the Arctic Ocean is becoming increasingly known to a wider public as the place where impacts of global warming manifest themselves in the most salient way. According to the fourth report issued by the IPCC (Intergovernmental Panel on Climate Change), average temperature increases at the Arctic in the past 100 years are approximately twice as much as the worldwide average.

The area of sea ice coverage has dropped significantly from the average figure for the second half of the last century (approximately 7 million km^2), recording an all-time low in 2007 when it was 4.2 million km^2. The other recent years that follow 2007 in the top-five list are 2011, 2008, 2009 and 2010.

<Lowest Recorded Annual Area of Sea Ice Coverage (As Measured Around September)>

1979 to 2000 average: 7 million km^2
2002: 5.7 million km^2 (80%)
2005: 5.3 million km^2 (75%)

2007: 4.2 million km^2 (60%)
2011: 4.5 million km^2 (65%)

If sea ice continued to decrease at this rate, there would be no ice left in the Arctic Ocean by 2030 to 2040.

While global warming is believed to be the main cause of the shrinking sea ice coverage, the fact that the Arctic Ocean has no land is another cited factor. The rate of sunlight reflection is 85 to 90% on snow or ice, 20% on land and 10% on oceans, which means that once ice is gone, an ocean surface becomes exposed, accelerating the pace of heating. This causes ice to further melt, which then leads to an even higher temperature and, hence, increasingly less ice. Comparing the Arctic to Antarctica, one can see that as Antarctica has thick ice lying on top of the land, which does not melt, the rate of sunlight reflection therefore remains high and global warming does not progress as steadily.

3. Shipping passages in the Arctic Circle

There are two shipping passages in the Arctic Circle, one along the Russian coastline and the other going alongside Canadian coastline, with the former being called the Northeast Passage and the latter the Northwest Passage.

The Northeast Passage by and large runs in shallow sea areas of the continental shelf, many of which have waters of less than 20 meters deep. While there is an official sea chart developed on the basis of one issued in the 1990s, a period marked by turbulent years, it is not clear whether or not data from any water depth surveys conducted later is reflected therein, a fact that requires caution as to the accuracy of information. The draft limit for the Northeast Passage (Northern Sea Route) used to be set at 12 meters and ships needed to sail through the shallow waters of the Sannikov Strait. However, as more ice has melted, it is now possible to navigate the waterway north of the Novosibirsk Archipelago, making it possible for large vessels to navigate there. While, as a result, maximum draft limits of 12 meters apply in the case of passage through the Sannikov Strait in the Novosibirsk Archipelago, vessels of deeper draft are now also able to pass through the Northern Sea Route when the waterway north of the Novosibirsk Archipelago is navigable (the maximum draft is set according to the sea ice condition, at the water depth of the navigable waters).

There is also a beam requirement that sets maximum limits of 30 meters (the beam of icebreakers). However, given the record that an LNG vessel (42 meters in beam) navigated there in 2012, however, the numerical beam limits will, in our view, likely be relaxed, considering the sea ice condition.

As the harbors that currently exist in a scattered fashion in the area extending for 2,550 miles between the Kara Gate Strait and the Bering Strait are all characterized by shallow waters and decrepit facilities, they are hardly sufficient for accommodating search and rescue, repair and evacuation shelter needs in the event that the full-scale development of commercial navigation begins in the future. Murmansk and Arkhangelsk, which are situated on the European side, are bustling with industrial activities, including exports.

Harbor name	Harbor specifications	
Pevek	200 m long; 4.9 to 6.1 m deep	Anchorage: 11 to 12.2 m deep
Tiksi	200 m long; 6.4 to 7.6 m deep	Anchorage: 6.4 to 7.6 m deep
Dikson	150 m long; 9.4 m deep	Anchorage: 6.4 m deep
Arkhangelsk	170 to 190 m long; 9.2 m deep	
Murmansk	13 berths; 6 to 12.5 m deep	

On the other hand, the Northwest Passage consists of a large number of routes that weave through as many as 19,000 islands situated in the Canadian part of the Arctic Ocean. For these waters, Canada applies the method of straight baselines to the islands in the Arctic Ocean and claims that the Northwest Passage that runs inside of the baselines is its internal waters. It cites as the rationale the fact that the waters and sea ice of the Northwest Passage have historically been used by the Inuit, an indigenous people, but the U.S. refutes the claim, arguing that the Northwest Passage represents an international strait where vessels have the right of transit passage. The two nations reached an agreement in 1988 in which they promise to respect their different claims and it is stated that U.S. icebreakers should be permitted to transit the Northwest Passage on a case-by-case basis.

Currently, it remains difficult for regular commercial vessels to transit the Northwest Passage and there is accordingly no history of, and no plan in sight for, such commercial transit because:

the range of industrial activities in the coastal areas is limited; it is challenging to forecast ice conditions due to their severity and wild swings and; there is no powerful icebreaker that could assist oceangoing vessels. For those reasons, the Northwest Passage was excluded from the coverage of this study.

4. Requirements for vessels transiting Russian seaways of the NSR

Since there is no treaty for the Arctic that is an equivalent of the Antarctic Treaty, the UNCLOS (United Nations Convention on the Law of the Sea) is applied to the Arctic Ocean. On the grounds of Article 234 of the Convention, which provides, "Coastal States have the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone, where particularly severe climatic conditions and the presence of ice covering such areas for most of the year create obstructions or exceptional hazards to navigation, and pollution of the marine environment could cause major harm to or irreversible disturbance of the ecological balance. Such laws and regulations shall have due regard to navigation and the protection and preservation of the marine environment based on the best available scientific evidence," the Russian government has set the following regulations for the purpose of ensuring safety for transiting vessels:

(i) Regulations for Navigation on the Seaways of the NSR

Navigation regulations that apply to vessels transiting Russian seaways of the NSR

(ii) Requirements for the Design, Equipment and Supplies of Vessels Navigating the NSR

Regulations that set vessel requirements for vessels navigating ice-bound seas (regulations similar to an Ice Class certification that shipping classification societies require for vessels navigating ice-bound seas)

(iii) Regulations for Icebreaker and Pilot Guiding of Vessels through the NSR

Regulations that provide the icebreaker escort service and the compulsory onboard ice pilot guiding service subject to exemptions

5. Transit procedures for vessels transiting Russian seaways of the NSR

A vessel to transit the Russian seaways of the NSR (the Kara, Laptev, East Siberian and Chukchi Seas) is required to conform to the regulations described in section 4 and must therefore file an application with the Russian government for the Ice Certificate issuance and a pre-navigational declaration and make arrangements for icebreaker escorting and pilot guiding services. Outlines of the respective procedures are described below:

(1) Application for the Ice Certificate issuance

An application must be submitted to the Central Marine Research and Design Institute, CNIIMF Ltd. (hereinafter the CNIIMF), for which required submissions include drawings from the ship's specifications and classification certificate. A certificate is valid for the period of ten years from the issuance and can be maintained upon renewal procedures. In the event that the ship's hull structure is modified or its main engine or main propulsion system is modified, a certificate needs to be reissued. As of December 2012, the stated amount of time required for the Ice Certificate issuance is approximately four months, and the stated fees are USD 20,000 (issuance fee) + USD 2,500 (onboard inspection fee, travel costs, etc.); however, amendments to Russian domestic laws in January 2013 have brought up hopes for a shorter lead time to the certificate issuance.

There have been cases of Ice Certificate applications where, even though the ship to pass through the Arctic Circle for practical use purposes did not necessarily meet all the regulations set by Russia, a certificate was granted with a period of time specified according to the sea ice condition; therefore, an application will likely be approved if the ship more or less has an Ice Class 1A or 1A Super classification given by a shipping classification society.

The IMO (International Maritime Organization) has developed its Guidelines (MSC/Circ. 1056 & MEPC/Circ. 399) as guidelines on the structural requirements for ships that pass through a polar zone, circulating it under the name of the "Polar Code." The IMO is currently discussing the possibility of making the Code enforceable; if a decision is made to make it enforceable, regulations will have to be matched accordingly.

The Ice Class rules of classification societies require higher strengths in outer plates and higher strengths or power in the main engine, helm and steering gear and propulsion system (propellers and shafting) in comparison to non-Ice Classed ships (ships that do not navigate in ice-bound seas). Major additions or modifications required for a non-Ice Classed ship to acquire an Ice Class 1A certification are stated below:

- Provide draft marks for measuring ice
- Use higher-strength hull outer plates, frames and stringers for better protection against ice

- Use higher-strength propellers, shafting and gear reducers
- Install ice knives for steering protection
- Place ladder stoppers for steering apparatus protection
- Apply anti-icing measures for ballast tanks above the lowest waterline

Additional costs for an Ice Class 1A certification can be anticipated to be roughly 15% of non-Ice Classed ship building costs, but an additional cost rate will vary depending on the propulsion system specifications or the type of ship.

(2) Pre-navigational declaration

This declaration must be submitted to the Administration of the Northern Sea Route (hereinafter the ANSR) and the main information to be declared is as shown below:

(i) Name of ship, IMO number, flag, port of registry, shipowner (full name and full address).
(ii) Gross/net tonnage.
(iii) Full displacement of the ship.
(iv) Main dimensions (length, breadth, draft), output of main engines, propeller (construction, material), speed, year of build.
(v) Ice class and classification society, date of last examination
(vi) Construction of bow (ice knife or bulb-bow)
(vii) Expected time of sailing through the NSR.
(viii) Presence of certificate of insurance or other financial security in respect of civil liability for environmental pollution damaged.
(ix) Aim of sailing (commercial voyage, tourism, scientific research, etc.).
(x) List of deviations from the "Requirements to the Design, Equipment and Supply of Vessels Navigating the NSR."
(For details, please see the following website:
https://www.bimco.org/en/Operations/Ice/Winter_Navigation/Northern_Sea_Route/~/media/Operations/Navigation/Ice_Information/Northern%20Sea%20Route/20120619-131248-DECLARATION_of_readiness.ashx)

As of December 2012, it is provided that a pre-navigational declaration must be submitted no later than four months before the scheduled navigation; a submission performed one month before may be approved in the case of an urgent need for navigation, in which case an extra charge applies in the transit fee.

Although the transit fee tariff is made public as shown on the site below, examples of ships that have actually navigated the NSR in the past reveal that there are differences between the tariff and the fees actually charged; therefore, charges need to be checked on a case-by-case basis.

(For the tariff, please see the following website:
https://www.bimco.org/~/media/Operations/Tariffs/Russia/Icebreaker_charges_NSR_2011_06_07.ashx)

The period of time from an application to the granting of the permit is estimated to be approximately one month but this is expected to improve due to application deadline and transit fee revisions scheduled to take place by the Russian government as a result of amendments to domestic laws at the end of January 2013.

The transit fee tariff will likely be calculated and set by reference to transit dues that apply to ships navigating the Suez Canal; from a perspective of users, the new tariff will hopefully be one governed by transparency, calculated on the basis of the actual pilot guiding service and icebreaker navigation costs as well as the route maintenance costs.

(3) Icebreaker support request: pilot arrangement

A request for icebreaker support or an application for pilot arrangement should be submitted to the ANSR Marine Operations Headquarters after a navigation plan is actually set.

The actual arrangement procedures for icebreaker support and pilotage are effectively handled by the Federal State Unitary Enterprise Atomflot (hereinafter Atomflot), which is located in Murmansk, in the case of entry to the NSR from the west and by the Far-Eastern Shipping Company (hereinafter FESCO), which is located in Vladivostok, in the case of entry from the east.

<Icebreaker fleet>

The Russian icebreaker fleet as it currently stands was formed in the days of the Soviet Union as a fleet of powerful icebreakers owned by the Soviet Union, and operated under navigation contract arrangements whereby the NSR was divided into eastern and western parts so that management should be shared between two shipping companies: the Far-Eastern Shipping Company (FESCO) in Vladivostok and by the Murmansk Ocean Company (present-day Atomflot) in Murmansk.

According to an announcement by the Russian government, there are supposedly six Arktika-type, nuclear-powered icebreakers that form the core of the icebreaker fleet (Arktika, Sibir, Rossya, Sovetskiy Soyuz and Yamal); however, those nuclear-powered icebreakers were all built by the Soviet Union and two of them are scheduled to be decommissioned by 2013 and be replaced with three ships that will be built anew. There is also information suggesting that there were only three core icebreakers that were actually operable in 2012, which implies a possibility that what have been used as NSR navigation support vessels are smaller nuclear-powered icebreakers that had previously been in operation mainly in harbors; this has given reason to suspect that after 2013, there may be a further shortage of icebreakers.

There are two modes of navigation for commercial ships in ice-bound seas of the NSR. When ice conditions are severe, with ice concentration – which indicates a relative amount of sea area covered by ice on a scale of 0 to 10 - in excess of 8/10, one icebreaker escorts one to two ships. If the concentration is roughly between 5/10 and 6/10, one icebreaker escorts three to four ships. The icebreaker support agreement contains a clause that in the event that a subject ship becomes unable to navigate unaided due to unexpected circumstances, such as an engine failure, the icebreaker should tow it. There is no record, however, of any large oceangoing vessel being towed to date and the only harbor in the vicinity of the NSR that could be a port of call for a large vessel is the one in Murmansk, the base point on the West side, with no harbor that could serve as an emergency port of call during the navigation; therefore, the development of harbors capable of accommodating a large vessel in case of emergency is awaited.

<Pilotage>

If the ship's master or navigation officer has the knowledge of navigation in ice-bound seas but lacks the experience of steering a vessel along the NSR for at least 15 days, the Russian authorities require that a pilot should be on board.

There are approximately 20 pilots currently employed and two pilots board a subject ship navigating the NSR. If necessary, a helmsman with experience of navigation in ice-bound seas will also be arranged. The service involved is similar to a regular pilot service where the ship master is responsible for the operation of the subject ship; for instance, pilots provide advice to the ship master, while any instructions to be given to the helmsman and the engine room should be given by the ship master of the subject ship.

It is required that communication with an icebreaker should be performed in Russian, so an ice pilot will have to be hired as the crew of the subject ship cannot speak Russian – even when the exemption for the pilot service does apply.

6. Navigation record

According to Russia's state-owned company "Rosatomflot," the freight transported via the Northeast Passage was 110,000 tons in 2010 but exceeded 1 million tons in 2012, much of which was petroleum products and iron ores and approximately 60% of which was from Europe and Russia to Asia; one of the factors contributing to this development is believed to be an intention of Russia's Vladimir Putin administration to expand its interests in the Arctic Ocean.

There were three oceangoing vessels that navigated the NSR in 2010, making a total of four transits through the Northeast Passage, carrying freight that added up to 110,000 tons.

(i) Baltica

A total of 70,000 tons of gas condensate was transported from Murmansk (Russia) to Ningbo (China); this marked the first-ever export of resources achieved by the navigation of the entire Northeast Passage.

(ii) Nordic Barents

Iron ores were transported from Narvik (Norway) to China with the nuclear-powered icebreaker Kina escorting the vessel; this marked the first-ever transportation passing through the Northeast Passage by a foreign-registered freighter.

(iii) Monchegorsk

This Russian Ice-Class (Arc 7) freighter with icebreaking capability, owned by Norilsk Nickel, took a return trip between Murmansk and Shanghai in October without icebreaker support, carrying metals outward and general cargo homeward.

The oceangoing freighter navigation record in 2011 shows that there were a total of 34 voyages (26 voyages were with cargo), carrying 820,000 tons of cargo, of which 682,000 tons (15 ships) were in liquid bulk form (gas condensate, etc.), 110,000 tons were in dry bulk form and 27,500 tons (in four ships) were frozen salmon, while there were eight empty voyages.

In 2011, the largest number of voyages were made between August and September and, among the ships that navigated the NSR, the earliest one did so in late June and the latest in mid-November. The year also marked the first-ever navigation by a Suezmax tanker: the Vladimir Tikhonov (162,000 tons in deadweight capacity) navigated north of the Novosiberian Islands instead of going through the Sannikov Strait, where waters are too shallow, to complete the Northeast Passage in the record-short 7.5 days. The Sanko Odyssey, owned by the Sanko Steamship Co., Ltd., passed through the Northeast Passage in eight days, transporting 66,000 tons of iron ores to China. There was information announced by Rosatomflot that 35 ships had been scheduled to transport 1,022,577 tons of cargo in 2012 but, as of November 7, 2012, the volume of transportation had already added up beyond that estimation to 1,126,640 tons (the main cargo being 486,920 tons of gas condensate), according to a report published by BARENTSNOVA (http://www.barentsnova.com/node/2126).

7. Economic impacts

This section focuses on the use of the Northern Sea Route in terms of whether it, being in the state it is in now, makes sense from a commercial standpoint.

In Japan, the Northern Sea Route (hereinafter referred to as the "northern route") is recognized as a shortcut for the shipping route linking Asia with Europe that currently exists[1].

In the past two to three years, there have been a series of new transportation of resources from the Scandinavian Peninsula (iron ores) or Barents Sea (gas condensate) in the direction of Asia, mainly China. Operators of ships that were actually involved in those cases have come to conclude that in the case of such transportation, it is economically more advantageous to use the Northern Sea Route than going through the Suez Canal and the Indian Ocean (hereinafter described as the "southern route")[2].

The author is well aware that some frown at the fact that Japanese shipping companies[3] are reluctant to use the NSR on the grounds that the ships used for navigating the northern route carry cargo bound for China, and Japan has little involvement in them[4].

Any actions that shipping companies take are, however, driven strictly by profit-making motives. There is accordingly no reason for them to select any route that is not economically justifiable even if it is geographically the shortest[5]. By the same token, the purpose of shipping companies does not rest with providing their home country with opportunities to show off its national pride.

(1) Verification in container ship operations

The types of cargo that have actually long been transported between Japan and Europe are containers (going both ways both bound; for specific details, see Figure 1) and finished motor vehicles (from Japan to Europe for the most part; also going in the other direction, but not so much).

The navigation route is essentially via the Indian Ocean and the Suez Canal (hereinafter referred to as the "southern route"). This means that for the "northern route" to be chosen, it will have to be economically more favorable than the southern route that is currently the norm.

In the meantime, just about the only possibility that currently exists of a Japanese business importing resources that lie in Northern Europe, the Arctic Ocean and alongside its coasts can be found in LNG in the Yamal Peninsula, of which shipment is expected to commence in 2016 to 2017. If the Japanese utility industry sectors decide to import it in consideration of the level of economic rationality of doing so, it should lead to an international tender being floated for a transportation contract, for which Japanese shipping companies will quite possibly make a bid[6].

For that reason, an economic comparison between the northern and southern routes will be presented here in the case of a container ship navigating between Japan (Yokohama) and Europe (Rotterdam).

(2) Assumptions for an economic comparison

Before performing an economic comparison, some matters that any businessman would consider will be discussed below.

(a) Nature of cargo

As is clear from Figure 1, cargo transported from Japan to Europe consists overwhelmingly of two types: highly advanced Japanese industrial products (finished goods) and; materials, components, intermediate parts and the likes to be used in factories established locally in Europe. The former is placed under a high level of marketing control, while the latter is subject to rigorous production control. In a nutshell, container ships that travel between Japan and Europe serve as something like conveyor belts in a factory and are therefore subject to stringent schedule compliance requirements.

Marketing management and production control exercised by shipping companies are tightly controlled on annual, monthly, weekly and daily bases. Put in plain language, the shipping would probably not welcome a shipping company whose chartering practice is characterized by, for instance, the lack of clear prospect as to when ice melts, claiming that it is an act of nature, or by precarious decision-making whereby the southern route is used until ice melts and is then switched to the northern route[7]. Such a practice is effectively tantamount to confessing that transportation involves uncertainty as if to say, "We won't know until we do it."

Figure 1: Container Freight Movements in 2011 (Europe to Japan) (Japan to Europe)

	Commodity	TEU (*)	Proportion	Total	Commodity	TEU	Proportion	Total
1st	Timber	137,161	20.5%	20.5%	Motor vehicles (finished/KD)	112,084	17.2%	17.2%
2nd	Beverages	50,887	7.6%	28.1%	Rubber products	83,068	12.8%	30.0%
3rd	Other food	46,776	7.0%	35.1%	Synthetic resin	76,101	11.7%	41.7%
4th	Paper and paper products	38,813	5.8%	40.8%	Parts of motor vehicles	65,736	10.1%	51.8%
5th	Non-ferrous metals	36,193	5.4%	46.2%	Machinery and equipment	53,681	8.3%	60.1%
6th	Motor vehicles (finished/KD)	30,417	4.5%	50.8%	Specialized industrial machines	29,697	4.6%	64.7%
7th	Wooden products	28,975	4.3%	55.1%	Organic chemicals	20,777	3.2%	67.9%
8th	Frozen seafood	26,619	4.0%	59.1%	Electronics	19,439	3.0%	70.8%
9th	Synthetic resin	24,476	3.7%	62.7%	Steel products	15,880	2.4%	73.3%
10th	Fruits and vegetables (preserved/dried)	23,196	3.5%	66.2%	Metal products	15,451	2.4%	75.7%
11th	Chemicals	19,991	3.0%	69.2%	Other machinery	11,326	1.7%	77.4%
12th	Parts of motor vehicles	15,362	2.3%	71.5%	Goods not classified by kind	10,900	1.7%	79.1%
13th	Furniture	15,137	2.3%	73.7%	Office equipment and computers	9,789	1.5%	80.6%
14th	Meat	11,716	1.7%	75.5%	Chemicals	9,406	1.4%	82.0%
15th	Fertilizers	11,001	1.6%	77.1%	Textiles	9,200	1.4%	83.5%
16th	Non-ferrous metal products	9,658	1.4%	78.6%	Metal or wooden machinery	8,951	1.4%	84.8%
17th	Goods not classified by kind	9,313	1.4%	80.0%	Engines and turbines	8,927	1.4%	86.2%
18th	Machinery	8,332	1.2%	81.2%	Agricultural machines	7,714	1.2%	87.4%
19th	Pulp	7,051	1.1%	82.3%	Precision machinery	6,188	1.0%	88.3%
20th	Tobacco	6,738	1.0%	83.3%	Plastic products	5,230	0.8%	89.1%
	Total	669,964			Total	650,087		

From figures reported by Global Insight

* Twenty-foot equivalent unit

There were occurrences of some cargo, such as precision machines, breaking or becoming damaged during a passage through a cold weather region that have been confirmed to have taken place when the Trans-Siberian Railway was used in the wintertime. It is a matter that needs examining separately as to whether industrial products coming from Japan might be damaged during navigation in ice-bound seas or whether some step must be taken for only a single-time passage through ice-bound seas.

(b) Can ships run at the same speed as along the southern route?

It often happens that a simple calculation is applied to conclude that the northern route, being shorter than the southern route in distance, should bring down the number of transit time between Japan and Europe. However, navigation of a ship at full speed in ice-bound seas would be unthinkable because the ship is guided by an icebreaker.

Take a voyage from Yokohama to Rotterdam: the author assumes that the northern route is 7,397 sea miles (all in normal waters) and the southern route is 11,279 sea miles. By applying a simple calculation, this would make the northern route 35% shorter in distance than the southern route (Figure 2).

In the right column, the area of ice-bound seas in the northern route (Kamchatka to Murmansk) is assumed to be 4,356 sea miles. This makes the area of normal seas 3,041 sea miles (Figure 2).

Assuming that a ship navigates at full speed – 26 knots – in normal seas and at 15 knots in ice-bound seas, it would take 17.4 days to complete the northern route and 19.6 days for the southern route. The effect of the northern route in terms of reduction of the number of transit time is merely 11%.

(c) Is the fuel cost assumption appropriate? In other words, is it not necessary to take the environment of the Arctic Ocean into consideration?

In the author's view, arguments that encourage the use of the NSR tend to assume, simply because of its shorter distance, that it should make the number of transit time less, resulting in a simple calculation being conducted to conclude that the volume of waste to be generated by ships (carbon dioxide, sulfur oxides, nitrogen oxides, etc.) should also become less. Considering, however, that even the North Sea and the Baltic Sea are defined as SECAs (SOx Emission Control

Areas) in Annex V of the IMO's MARPOL Convention[8], it would be more realistic to perform any estimation with the Arctic Ocean being assumed to be defined as a SECA. In short, calculations should really be conducted on the assumption that ships use fuel oil in normal seas[9] and diesel oil in ice-bound seas[10].

(d) Problem of ship size

The Europe-bound container ships that are currently under the control of Japanese shipping companies are vessels of 8,000 to 9,000 TEU (capable of loading 8,000 to 9,000 20-foot containers)[11]. These vessels currently cannot pass through all parts of the Arctic Ocean where ice melts in the summertime – the waters in some straits are too shallow.

Therefore, the northern route could currently[12] only accommodate ships up to approximately 4,000 TEU (capable of loading 4,000 20-foot containers).

(3) Economic assessment

With the assumptions above taken into account, an economic assessment will be performed for the northern and southern routes, respectively. This represents a model calculation done on the assumption that Yokohama and Rotterdam are the only ports of call[13].

For the northern route, the calculation will be performed on the basis of a 4,000-TEU container ship (assuming 55,000 tons in deadweight capacity, USD 13,000 per day in charter fees[14] and 130 tons per day in fuel consumption[15]).

For the southern route, an 8,000-TEU container ship (assuming USD 25,000 per day in charter fees, 200 tons per day in fuel consumption) will serve as the basis.

Fuel oil costs change considerably as crude oil prices fluctuate. The cost assumed is USD 650 per ton for heavy fuel oil and USD 1,000 per ton for diesel oil. It is assumed in the case of the northern route that diesel oil should be used in ice-bound seas.

A transit through the Suez Canal by an 8,000-TEU container ship is assumed to cost USD 550,000 by reference to the tariff of the Suez Canal Authority.

While fees to be charged as the consideration for the icebreaker service, pilotage, a pre-navigation ship inspection, etc. for a ship navigating the Arctic Ocean just have to be estimated from past press coverage, it is assumed in this study that they amount to USD 8.4 per deadweight ton[16]. This amounts to USD 473,000 for the northern route.

As a result (Figure 3), the total expenses would be USD 2.89 million for the northern route on the assumption of a 4,000-TEU container ship making a one-way trip, while the equivalent for the southern route would be USD 3.59 million on the assumption of a 8,000-TEU container ship making a one-way trip. These figures converted into expenses per 20-foot container would be USD 448 for the southern route and 722 dollars for the northern route. While the number of transit time could be expected to be a little more than two days shorter, the northern navigation would thus be approximately 60 percent more expensive than the southern one.

The end.

Figure 2

	Unit	Via Suez	Via Arctic
Vessel Size	TEU	8,000	4,000
Distance		11,279	7,397
Arctic Sea	Sea Mile	0	4,356
Normal Sea	Sea Mile	11,279	3,041
Speed			
Arctic Sea	Knot/hour	—	15
Normal Sea	Knot/hour	24	24
Transit Time			
Arctic Sea	Day	—	12.1
Normal Sea	Day	19.6	5.3
Total	Day	19.6	17.4
Fuel Consumption	Ton/Day	200	130
Diesel Oil	Ton	0	686
Fuel Oil	Ton	3,916	2,259
Total		3,916	2,946

Figure 3

	Unit	Via Suez	Via Arctic
Unit fuel cost			
Diesel Oil	USD/Ton	1,000	1,000
Fuel Oil	USD/Ton	650	650
Fuel Cost	USD 10,000	255	215
T/C Rate	USD/Day	25,000	15,000
	USD 10,000	49	26
Suez Canal	USD 10,000	55	0
Icebreaker, etc.	USD 10,000	0	47
Total Cost	USD 10,000	359	289
Cost/TEU	Dollars/TEU	448	722

(4) Verification in bulker operations

What is presented above are the results of a verification of economic impacts with reference to container ships; in contrast, below are the results from a verification on the basis of case examples of a bulker navigating the Suez Canal and one navigating the Arctic Ocean, both between Europe and Asia, conducted on the basis of information acquired by the members:

〈Navigation Record Comparison〉

Route: Kirkenes (Norway) → Qingdao (China)

Distance: Shortened by 5,699 miles (12,234 miles – 6,535 miles)

Days: Shortened by 19 days (41 days – 22 days)

Fuel: Reduced by 530 tons (1,150 tons – 620 tons)

Fuel cost: Cut by USD 350,000 (USD 660 per ton)

<Incidental Cost Comparison>

A. Suez Canal navigation:	Total USD 284,000
Insurance cost:	USD 7,000
Cost of anti-piracy measures:	USD 80,000
Suez Canal transit fee:	USD 197,000
B. NSR navigation:	Total USD 266,000
Ice Certificate issue fee:	USD 25,000
Ice Permission issue fee:	USD 4,000
Insurance cost:	USD 37,000
Icebreaker and other cost:	USD 200,000

If the cost of anti-piracy measures among the incidental costs for the Suez route is considered to be an initial investment, it should not be included in the coverage of comparison, in which case the NSR turns out to be approximately USD 60,000 more costly.

In the meantime, the navigation record shows that with a fuel cost improvement by USD 350,000 and the reduced number of days of navigation (on the assumption that the "hire-based" cost[17] is USD 10,000 per year) taken into account in the assessment, the reduction of 19 days would lead to an improvement by USD 190,000 in one-way navigation cost, which translates to an improvement of the cargo transportation cost by USD 480,000 in one-way navigation, even with the USD 60,000 negative impact on the incidental costs discounted.

Assuming that the period during which NSR navigation is possible would be three months and three NSR voyages could be made annually, costs could be improved by USD 2.88 million per year as a result. This implies that on the basis of a 15-year depreciation period[18], there would be a cost improvement by USD 43.2 million, an amount that could allow for increases in building cost, administrative costs, etc.

In the case of a bulk carrier, a cost improvement can thus be expected from navigating the NSR, compared to passing through the Suez Canal, depending on the ship charter agreement and cargo trend. This is a finding in line with an observation by a bulker operator that has actually had its ship navigate the Arctic Ocean.

8. Recommendations for Arctic navigation

(i) Improved meteorological and oceanic observations for the Arctic Ocean

Improve forecast accuracy that would facilitate more in-depth navigation planning, and investment in actions needed for that purpose. Specifically, launch an artificial satellite for polar observation purposes (*Assistance to a Japanese private business, such as Weathernews Inc., would also work). Build an observation ship with an icebreaking capability for NSR navigation purposes and perform observations in the Arctic Circle.

(ii) Pursuing possibilities of resources transportation

If it can be expected that resources could be transported from the Northern European region to Japan (with the Yamal Peninsula in mind) on a constant basis, establish a framework for a possible all-Japan initiative and examine the financing for construction of competitive vessels provided by the JBIC, etc.

(iii) Having dialogue with Russia – ensuring more transparency in information

While an NSR transit requires a series of special navigational support and services (icebreaker, pilotage guiding and meteorological forecasts), the particulars of the costs for supplying and maintaining such services have not been made transparent. Hopefully, clarity will be ensured in the costs required for safe navigation and users should be charged appropriately.

User charges should not be determined in comparison with the Suez Canal transit costs.

(iv) Increasing the number of nuclear-powered icebreakers

As the number of ships navigating the NSR grows in the future, the number of icebreakers required will likely rise as well. If the Russian government's funding alone is not sufficient, it might be necessary to examine, for instance, allowing in foreign capital to ensure that it should have the required number of nuclear-powered icebreakers.

(v) Government's commitment to developing human resources with special skills

Develop Arctic personnel with an arts background, Arctic personnel with a science background, and sailors (not limited to the Japanese)

(vi) Improving the IMO's presence in NSR navigation rules

Instead of having each coastal state establish rules at its discretion and make the international community comply with them, lobby that ships could, as a general rule, navigate the NSR pursuant to navigation rules deliberated by the IMO and recognized internationally.

(vii) Verifying the emergency response structure in the event of a large vessel becoming involved in trouble at sea

While Murmansk, which is the Western base point of the NSR, has a quay and an anchorage that can accommodate deep-draft ships, there is currently no port alongside the NSR that could serve as a haven in times of emergency during navigation. Given the prospect that the increasing number of larger-sized vessels will likely navigate the NSR as more sea ice melts, efforts are needed to work on the development in this area.

In the event that a ship becomes in need of towing support during its transit through the NSR, a towing service is available in the form of an escorting icebreaker; as, however, concern remains as to whether an icebreaker is capable of engaging in a rescue operation concurrently with the escort service, it is necessary to verify the marine salvage system.

While, further still, the coastal states have an agreement that each of them should take steps to develop a system for protection against oil spillage in the event of an oil-spill incident resulting from a collision, stranding or other occurrence involving a ship and, presumably, the knowledge of such a system is disseminated on a national level, it is desirable to request that such information should be disclosed to third countries for external recognition as well.

— Notes —

[1] Expressions like Asia and Europe are, however, quite vague from a perspective of shipping practices. Traditionally, a substantial number of arguments that find the NSR more advantageous than

the southern route refer to Asia to mean Japan (Yokohama) and refer to Europe to mean Northern Europe (Hamburg). Considering the actual state of container ship cargo shipments and discharges on Asia-Europe navigation routes, however, this is a "far-fetched" assumption that is favorable to the northern route. More than 60 percent of Asian-originating cargo is made up of cargo shipped out of China and Hong Kong, and Rotterdam or Antwerp should really be the most important port amongst the ports of discharge on the European side. Sung-Woo Lee, Director of the International Logistics Department, Korea Maritime Institute in Korea, has performed an in-depth analysis in this regard. According to his study, a closer look at the Asia-Europe navigation routes suggests that while the northern route is more advantageous for Japan and Korea, the difference is only half day at most for Taiwan and South China. On the European side, it is utterly disadvantageous for Southern Europe (Sung-Woo Lee, *Paper 2: Benefits of the Northern Sea Route to the North Pacific*, 2011 EWC/KOTI Conference, 8-9 August 2011, Opening the Northern Sea Route and Dynamic Changes in North Pacific Logistics and Resource Security, Table 1).

[2] For example, information publicized by Nordic Bulk Carriers S.A. (a Danish marine transporter): http://www.nordicbulkcarriers.com/images/Media/Filer/nsr_factsheet_uk.pdf

[3] In 2011, the Sanko Odyssey (75,612 tons in deadweight capacity), a bulk carrier that is a flag of convenience ship owned by Sanko Steamship, transported iron ores from Northern Europe to China. It was used for regular chartering by Nordic Bulk Carriers S.A., a Danish operator, so as to engage in what is called subcontracted transportation, and thus did not involve a transportation agreement being made by Sanko Steamship with the shipper. On a related note, this ship was bought by Nordic Bulk Carriers S.A as a result of Sanko Steamship going bankrupt.

[4] In most cases, "Japanese shipping companies" engage in transportation by chartering ships owned by their foreign subsidiaries not incorporated in Japan (foreign-registered ships). In other words, it is extremely rare for them to operate Japan-registered ships. If the Japanese government is to make any argument against the Arctic coastal states from the viewpoint of advocating interests of "Japanese shipping companies," it will need to deal with this point accordingly.

[5] During the summer 2012, however, there were cases of jet fuels being transported on a regular basis from Yeosu, Korea, to Finland. Since this was a move that would be unthinkable in the normal context of petroleum product trade, the author suspects that some other motive was at play (for example, a subsidy given by the Korean government to the oil company or shipping company), albeit not substantiated.

[6] For instance, it was reported in the November 28, 2012 issue of *Daily Kaiji Press* that business negotiations have begun with respect to a ship charter, resulting in 13 companies successfully passing a preliminary qualification screening conducted by the project operator, with Russia's Sovcomflot (a state-owned tanker company), Stena LNG (a Swedish shipping company affiliated with an oil company), Teekay LNG (a Canadian shipping company) and Nippon Yusen being named among them.

[7] For the purpose of shipping practices, the lack of predictability of meteorological and oceanic conditions for at least one week ahead will pose problems in the actual navigation. In the Arctic Ocean, meteorological and oceanic condition forecasts down to that level of accuracy are still in the research stage. In this sense, an idea of building an Arctic observation ship with an icebreaking capability for that purpose is supportable.

[8] International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (Treaty No. 3 of 1983).

[9] Large container ships are loaded with roughly 3,000 to 5,000 tons of heavy fuel oil, which is an equivalent to a volume carried by a small tanker. It should be remembered that an oil-spill disaster in the event that the fuel tank is destroyed as a result of the ship colliding with an iceberg, etc. would not only subject the ship owner to civil liability but also lead to a serious problem in terms of environmental damage. Generally speaking, it would be extremely difficult to recover fuel oil leaked in ice-bound seas.

[10] That said, regulations on sulfur content in fuels will eventually be tightened in non-SECA normal seas as well, which means that in practice, the same types of fuel will be used, whether in normal or ice-bound seas. The calculation in section (3) is performed by using the same fuel use conditions. Without going into the details and skipping right to the conclusion, the cost per TEU shipper would be 550 dollars in the northern route and 448 dollars in the southern route. Simply put, it is thus a question as to whether a shipper would accept roughly 20 percent increases in freight charge in exchange for saving a little over two days of reduction in the number of transit time.

[11] This holds true for Japanese shipping companies only. European and non-Japanese Asian shipping companies in service for Europe-bound shipments use mega-ships up to 10,000 TEU or greater. It might be more realistic to examine this point in the first place.

[12] As a matter of course, this is the current state of affairs and will cease to be true if more ice melts in the future. Given the record of the LNG vessel Ob River navigating the route, a ship larger than 4,000 TEU container ships may be able to make a passage even now. The bare conclusion of calculations using the same method as the one under section (3) of this article, conducted on the assumption that an

8,000-TEU vessel is - as with the southern route - able to make it, suggests that the cost per TEU shipper would be 305 dollars in the northern route and 448 dollars in the southern route. If economy of scale could apply in the northern route in much the same way as in the southern route, the northern route might be proven economically more advantageous.

[13] In the case of the southern route, it would really be more natural to assume that the ship should make port calls on her way, which would then add to the days of navigation as usual.

[14] A ship's value sways according to the shipbuilding demand and supply balance, with ships of the same type possibly costing different amounts depending on the timing of the order. The capital cost to the ship owner also varies substantially depending on how favorable a financial deal it can arrange. Accordingly, it was decided that the calculation should be based on the market value of charter fees (inclusive of crew cost, hull insurance premiums, PI insurance premiums, repair cost, lubricant cost, capital cost, etc.) as applicable when the author reported on this issue in the Study Group.

This reflects a consideration of the fact that the issue of how marine insurance to be applicable for navigation in the Arctic Ocean would be structured is still up in the air. It is said that the Arctic Ocean would be outside of the trading area coverage of marine insurance and would therefore be subject to insurance premiums higher than normal. Broadly speaking, two types of marine insurance could be envisioned: cargo insurance paid for by shippers and hull insurance paid for by ship owners. The prospect remains vague for the former; when the author inquired with a Japanese marine insurance company about the latter, they replied that double the regular premiums are charged.

[15] Unit fuel costs change daily; they vary according to the timing of the replenishment.

[16] When a Suezmax tanker owned by Sovcomflot, Russia's state-owned tanker company (162,000 tons in deadweight capacity) navigated the NSR, these fees were reportedly USD 4.3 per ton; however, some point out that they were special prices for cargo bound for Russia, and were about half the regular rates.

[17] (Supplementary information) A “hire-based” cost refers to a cost applicable for the period during which a ship is operable at any time, as standardized per calendar day. In the Japanese shipping industry, the sum total of the direct ship costs (crew cost, repair cost, lubricant cost, hull insurance premiums, ship supplies and other administrative costs) and the indirect ship costs (capital cost for the ship) has traditionally been called a “hire-based” cost.

As a “hire-based” cost can be regarded as the cost held on the part of the ship owner when a ship is hired for a time charter, this assumption is equivalent to the time charter fee assumed in the example of a container ship previously discussed.

[18] As has been discussed in note 14 above, depreciation cost is also swayed by the ship's value after all. A ship's value does not represent a cumulative value of costs at the dockyard but fluctuates depending on shipbuilding demand and supply conditions. Even if a ship of the same specifications is ordered from the same shipbuilder, the value varies greatly depending on at what timing the order is placed. In the extreme, the highest value could be double the lowest value.