

Original article

The Northern Sea Routes and Korea's Trade with Europe: Implications for Korea's Shipping Industry*

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Abstract

Melting Arctic waters have brought about global opportunities and challenges. One distinctive opportunity presented by the increasingly ice-free Arctic Ocean is its availability for shipping cargos between Europe and Asia. In adopting highly simplified assumptions of the Northern Sea Route (NSR) being navigable and economical enough for shipping and NSR completely substituting for the incumbent Suez Canal route, this paper analyzes the maximum number of voyages possible for the transshipment of container cargo throughput for Korea's trade with Europe, particularly with Europe-17 and Europe-7. Our analysis shows the number of voyages range from over 2,900 to as little as 237 for Europe-17, depending on vessel sizes, when NSR is available for the whole year. With NSR opening for three months, the corresponding figures vary between 727 and 60 for Europe-17, and the figures for Europe-7 are between 2,725 and 222 and 682 and 56 voyages, respectively.

Keywords: NSR, Korea, Europe, Voyages, Container

I. Introduction

The formerly ice-covered Arctic is undergoing extraordinary transformations as a result of the ice receding at an unprecedented rate. Increases in near-surface temperature in the Arctic since 1980 have been twice as fast as they have been in the rest of the world, and thus the Arctic is certainly on the frontier of global climate change impacts (Polar Regions Department, UK, 2013). The Arctic Ocean ice has shrunk on average by 2.7% per decade, and during the summer months the diminution has been more severe with an average decrease of 7.4% per decade. According to the National Snow and Ice Data Service of the United States, the 2014 Arctic maximum ice coverage was the fifth lowest since 1978 (NSIDS, 2014). Thus, Arctic sea, once dense with ice floes, has become increasingly navigable by ships. One report even predicted that the Arctic Ocean will become ice free around 2070 – 90 (Jakobson, 2010, p.1).

Undoubtedly, the melting of Arctic ice, its consequence and global impacts will pose economic, military and environmental challenges to the governance of the region, as well as various opportunities. Therefore, many countries including member and observer countries of the Arctic Council are in a rush to join the 'grand polar race' and formulate their own Arctic policies and strategies while trying to orchestrate these efforts at a global scale. One of the most significant opportunities associated with the melting of the Arctic Ocean will be using the northern routes, the Northwest Passage and the Northern Sea Route (NSR, hereafter) for shipping cargo from Europe to Asia and to Canada and the US, in spite of potential risks and the complexity of the issues surrounding the Arctic Ocean navigation. Recently, the traffic via the northern routes has increased significantly. In 2013, for example, a total 71 vessels navigated NSR with over 1.3million tons of cargo, of which liquid, LNG and bulk cargos accounted for over 92% (Table 1). Some estimates predicted that by 2030 more than 64 million tons of cargo would be shipped via NSR (Keil, 2014). Using the northern routes shortens the distance and saves on fuel consumption, thus resulting in an overall reduction in the transportation cost *ceteris paribus*, and savings could be substantial, especially for many Asian countries. Some Asian ports high in latitude may potentially become new centers for international shipping with NSR opening up for shipping. Accordingly, global trade and shipping patterns may change in the favorable way for China, Korea, Taiwan, and Japan.

Korea shows resilient interests in the melting Arctic for the development of untapped energy and other natural resources but more for the possibility of using NSR for shipping cargos linking Europe. Korea's total cargo volume shipped through NSR in 2012 was 564,355 tons with 431,387 tons east bound and 132,968 tons west bound, respectively. In 2013, cargo volume was slightly down with the corresponding figures of 382,945 tons of cargo in total, 182,139 tons east bound and 200,806 tons west bound, respectively. The types of shipped cargo via NSR were predominantly of bulk or bulk liquid such as gas condensate, naphtha, jet fuel and gasoline. However, in 2013 the throughput of 16,651 tons of general cargo was shipped from Busan to Rotterdam in the Netherlands by a Hong Kong flag carrying vessel, called *Yongsheng*. This particular transshipment of general cargos via NSR further enhances the possibility that the

throughput of more cargos can be made via NSR as an alternative shipping route for Korea's trade with European countries.

Table 1: Global NSR Transit Statistics

Type of cargo	2013 Transit			2012 Transit		
	Amount of vessels	Cargo volume, tones	Full displ. (FD), tones	Amount of vessels	Cargo volume, tones	Full displ. (FD), tones
Liquid	31	911,867		26	894,079	
Bulk	4	276,939		6	359,201	
LNG	1	66,868		1	8,265	
General cargo	13	100,223		0		
Ballasting	15		469,703	6		472,075
Reposition	7		38,027	7		78,351
TOTAL:	71	1,355,897	507,730	46	1,261,545	550,426

Source: Northern Sea Route Information Office, *Transit Statistics*, 2012-2013 issues

The melting of the Arctic Ocean has stimulated numerous modeling efforts for Arctic shipping (Lasserre, 2014). Among 26 simulations efforts made between 1991 and 2013, according to Lasserre (2014, 145-150), 20 have been conducted since 2006, and the majority of these studies, in fact 20 out of 26 efforts, dealt with NSR transit shipping. He noted further that these studies focused on container traffic in 18 out of 26 cases and that most of the previous studies tackled the profitability of the shipping via NSR, in 20 out of 26 cases, compared to conventional shipping routes such as the Suez Canal route. However, he noted that the conclusions reached by these studies including his own, especially for NSR being more profitable than the conventional routes, were sensitive to the parameter values used in the modeling efforts, thus requiring cautions to be taken in interpreting the results. It should be acknowledged that there are many composite issues and risks associated with NSR navigation for shipping. Even with cargos available for transshipment via NSR, the decision making of whether to use NSR would ultimately depend on the complex interactions of at least three main stakeholders, i.e. cargo owners, vessels operators, and Russia. Lee et al.(2011) made an extensive effort to investigate the prospect of using NSR for Asian six countries: Korea, China, Japan, Taiwan, Hong Kong and the Philippines. Under the various scenarios on the parameters, they identified under what conditions NSR would be more profitable than the Suez Canal route and how much of the traffic from the Asian six countries to Europe could be switched to NSR shipping from the conventional route under such conditions. Although some projections were made regarding NSR traffic volume for the Asian six countries, unfortunately they neglected an in depth analysis of the volume of containers for Korea's trade with European countries. Therefore, it is imperative to analyze how much of cargo will be

available for shipping between Korea and Europe, which is the main purpose of this paper. In section 2, Korea's recent trade with Europe will be analyzed to emphasize its specific characteristics, especially highlighting the trade with Russia. It is partly because potential benefits of using NSR are the shipments of cargo linking Europe and Asia and also because with resource development in the northern part of Siberia and other parts close to the Arctic the substitution of cargo shipment such as coals, iron ores, oils, natural gas and other minerals is highly feasible away from traditional origins/destinations and their shipping routes. In section 3, an attempt will be made, by using a pro-rata technique of benchmarking, to conjecture on the maximum cargo throughputs available for the transshipment via NSR, and section 4 will conclude the paper with some implications for Korea's shipping industries.

II. Korea's Foreign Trade with Europe and Russia: Characteristics of Cargo

Table 2 shows Korea's trade with Russia, the European Union (EU), Europe and the world in the period of 2010-2013¹ both in terms of value and volume. In terms of value, Korea's global trade in 2013 was US\$1,075.2 billion, up by over 20% from US\$891.6 billion in 2010. Korea's trade with Europe increased by 15.3% in the same period to US\$144.6 billion, from US\$125.4 billion. Approximately 88% of Korea's trade with Europe was carried out with the EU and Russia over the same period. For example, with the EU and Russia, in 2013 Korea traded US\$105.1 billion and US\$22.6 billion, respectively which accounted for 72.7% and 15.6% of the Korea's total trade of US\$144.6 billion with Europe. These exports were equivalent to increases of 13.9% and 28.2% from the corresponding figures in 2010.

While the growth rates of Korea's global trade during this period were almost equally shared among exports and imports, i.e. the former, 20.0% and the latter, 21.3%, Korea's trade with Europe shows a stark difference. Korea's imports from Europe grew rapidly by more than 38%, but Korea's exports to Europe in contrast decreased 0.6% during the same period. The main thrust for the increase of Korea's trade with Europe is attributed to Korea's imports from the EU, from US\$38.7 billion in 2010 to US\$56.2 billion in 2013, a whopping 45.2% growth. On the contrary, exports to the EU shrank by 8.6% in the same period to US\$48.9 billion in 2013, from US\$53.5 billion in 2010.

As seen in Table 2, the total volume of Korea's trade grew by slightly over 10% in the 2010-2013 period, from 772,317,623 MT (metric ton) in 2010 to 851,848,609 MT in 2013: imports by 8.6% and exports 14.7%. As for Korea's trade with Europe, the overall volume increased to 71,441,559 MT in 2013 from 53,098,535 MT in 2010, an increase of 34.5%. In the corresponding period, exports to Europe were 18,423,070 MT, up by 24.6% from 14,784,343 MT, and imports were 53,018,489 MT, up 38.4% from 38,314,192 MT. The volume of Korea's exports to Russia grew even faster with an increase of 30.4%, more than the import volume which increased by

¹ This period overlaps with the Global Financial Crisis period during which member countries of the EU endeavored to recover from the crisis. It also includes the time period when Korea-EU Free Trade Agreement (FTA) came into force from 2011.

20.9%. The fact that the volume of Korea's imports from Russia is more than 10 times larger than the volume of exports during the same period indicates that Russia's cargo was mainly of bulk type.

Table 2: Korea's Trade with the Europe and Russia (2010-2013)

Region	Year	Export		Import		Total	
		Value (US\$B)	Volume (MT)	Value (US\$B)	Value (US\$B)	Value (US\$B)	Volume (MT)
EU	2010	53.5	12,554,814	38.7	6,241,482	92.2	18,796,296
	2011	55.7	12,445,344	47.4	6,474,548	103.2	18,919,892
	2012	49.4	12,003,239	50.4	11,234,749	99.7	23,237,988
	2013	48.9	11,485,691	56.2	12,860,917	105.1	24,346,608
Russia	2010	7.8	1,839,552	9.9	22,731,611	17.7	24,571,163
	2011	10.3	2,437,472	10.9	23,966,195	21.2	26,403,667
	2012	11.1	2,561,934	11.4	24,248,035	22.5	26,809,969
	2013	11.1	2,398,754	11.5	27,488,525	22.6	29,887,279
Europe	2010	69.6	14,784,343	55.8	38,314,192	125.4	53,098,535
	2011	75.1	18,200,411	65.3	41,777,465	140.4	59,977,876
	2012	68.3	17,040,165	71.3	50,343,072	139.6	67,383,237
	2013	69.2	18,423,070	75.4	53,018,489	144.6	71,441,559
World	2010	466.4	213,967,940	425.2	558,349,683	891.6	772,317,623
	2011	555.2	249,856,218	524.4	597,837,817	1,079.6	847,694,035
	2012	547.9	246,629,462	519.6	602,334,367	1,067.5	848,963,829
	2013	559.6	245,520,486	515.6	606,328,123	1,075.2	851,848,609

Source: Korea Customs, Trade Statistics (<http://www.customs.go.kr/>)

Korea's top 10 export items to Russia were predominantly manufactured goods and accounted for 89% of the total exports of US\$11.1 billion in 2013. As seen in Table 3, Korea's no.1 export item was vehicles with over US\$5.3 billion, followed by machinery (US\$1.6 billion), electrical equipment (US\$1.1 billion), and chemical products (US\$0.7 billion), which are mostly manufactured goods. On the import side, the imported goods were mainly natural resource based or resource intensive products such as oils, iron and steel, aluminum, etc. Mineral fuels and oils was the largest importable in 2013 with US\$8.5 billion, followed by iron and steel products (US\$0.7 billion), fish and crustaceans (US\$0.6 billion) and aluminum (US\$0.5 billion).

Table 3: Korea's Top 10 Export to and Import Items from Russia (2013)

	Nomenclature	HS Code	Weight (MT)	Value (US\$M)
Export	Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	87	544,050	5,349
	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	84	209,052	1,603
	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles	85	61,979	1,060
	Miscellaneous chemical products	39	349,402	727
	Iron and steel	72	239,524	277
	Plastics and articles thereof	40	54,901	260
	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof	90	5,341	204
	Aircraft, spacecraft, and parts thereof	88	80	159
	Articles of iron or steel	73	58,793	144
	Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, not elsewhere specified or included; illuminated sign illuminated nameplates and the like; prefabricated buildings	94	19,719	131
	Total			2,398,755
Import	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	27	24,515,245	8,537.6
	Iron and steel	72	1,532,702	742.6
	Fish and crustaceans, molluscs and other aquatic invertebrates	3	288,500	587.9
	Aluminum and articles thereof	76	245,712	543.2
	Inorganic chemicals; organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or of isotopes	28	2,256	343.7
	Ores, slag and ash	26	31,916	127.3
	Wood and articles of wood; wood charcoal	44	383,179	120.9
	Pulp of wood or of other fibrous cellulosic material; waste and scrap of paper or paperboard	47	181,486	110.2
	Cereals	10	194,252	50.5
	Plastics and articles thereof	40	16,239	50.0
	Total			27,488,525

Source: Customs Korea, Trade Statistics

Table 4 shows the number of containers for the export between Korea and Europe in 2010-2013. The total number in 2013 is 2,449,539 TEU, up from 1,852,118 TEU in 2010. Among these containers, approximately 52% are for exporting and 48% for importing. 92 ~ 97% of the numbers are accounted for by the EU and Russia, averaging roughly 94% for the period while those containers with the EU are about 2/3 and Russia 1/3, respectively. One interesting feature

observed from the number of containers is the percentage of empty containers. In exporting, slightly over 1% of the total export containers are empty for the Europe bound cargo, whereas over 35% of the Korea's import containers from Europe are empty. This extreme unbalance in the number of empty containers is associated with the fact that while 0.3% of the Korea's exports to Russia are empty containers, more than 76% of the imports from Russia are empty containers. Nevertheless, all the container throughput can potentially be considered for shipping via NSR. Out of 2,449,539 TEU containers in 2013, up to 612,385 TEU and 1,224,770 TEU can be transported via NSR if it is open for navigation, for three months and six months, respectively.

Table 4: Container Volume for Korea-Europe Trade (TEU) (2010-2013)

Containers (TEU)		Export				Import			Total
		FCL	LCL	EMPTY	Sub Total	FCL	EMPTY	Sub Total	
Europe	2010	944,686	33,159	10,926	988,770	572,831	290,517	863,348	1,852,118
	2011	1,071,198	36,022	12,055	1,119,275	649,875	390,974	1,040,849	2,160,124
	2012	1,098,532	38,557	13,026	1,150,114	735,347	370,967	1,106,313	2,256,427
	2013	1,192,951	54,265	15,130	1,262,346	765,613	421,581	1,187,193	2,449,539
EU+Russia	2010	861,020	28,014	10,902	899,935	542,052	262,810	804,862	1,704,797
	2011	995,312	34,826	13,127	1,043,265	619,443	369,314	988,756	2,032,021
	2012	1,075,316	50,477	13,843	1,139,635	698,498	353,004	1,051,500	2,191,135
	2013	1,086,318	52,967	13,546	1,152,831	721,375	406,921	1,128,297	2,281,128
EU	2010	536,104	11,057	10,211	557,372	498,866	121,675	620,541	1,177,913
	2011	585,805	12,891	11,294	609,991	565,331	139,845	705,175	1,315,166
	2012	665,809	28,542	12,010	706,361	621,777	126,158	747,933	1,454,294
	2013	665,809	28,542	12,010	706,361	627,491	156,843	784,335	1,490,696
Russia	2010	324,916	16,957	691	342,563	43,186	141,135	184,321	526,884
	2011	409,507	21,935	1,833	433,274	54,112	229,469	283,581	716,855
	2012	409,507	21,935	1,833	433,274	76,721	226,846	303,567	736,841
	2013	420,509	24,425	1,536	446,470	93,884	250,078	343,962	790,432

Source: Trade Statistics Service, Korea (<http://trass.kctdi.or.kr/service/statistic/>)

III. Container Ship Voyages via the Northern Sea Route for Korea-EU Trade

As of the year 2013, the total number of throughput containers transported between Korea and Europe amounts to 2,449,539 TEU with 1,262,346 TEU for export and 1,187,193 TEU for import,

respectively. However, shipping via NSR is not advantageous in terms of saving distance for every country or port in Europe with regard to trade with Korea. Lee et al. (2011) identified that 17 European countries, i.e. Europe-17, including Russia will benefit from saving distance with the opening of NSR and that all these countries are located north and west of Italy (pp. 70-73). Table 5 shows the throughput container for Korea's trade with Europe-17 in 2013 and the distance saved from the major ports of these 17 European countries to Busan, Korea when the navigation is made via NSR, instead of the Suez Canal route. Distance saving varies widely depending upon the locations of the major ports in each country: that is, distance saving is as large as 3,787km for Reykjavik Port, Iceland to Busan and as little as 1,063km for Lisbon, Portugal to Busan.

Table 5: Throughput of Containers between Korea and Europe-17 (2013)

Country	Major Port	Distance Saving ¹	Export (TEU)	Import (TEU)	Total (TEU)
Russia	Saint Petersburg	3,706	446,470	343,962	790,432
Germany	Bremen	3,373	194,071	203,900	397,971
Netherlands	Rotterdam	3,082	103,496	126,347	229,843
UK	Felixstowe	3,002	26,622	71,352	97,974
Belgium	Antwerp	3,010	38,310	57,137	95,447
Poland	Gdynia	3,706	78,218	11,019	89,237
France	Le Havre	2,725	25,355	44,661	70,016
Finland	Helsinki	3,706	4,319	25,913	30,232
Sweden	Gothenburg	3,706	4,162	23,192	27,354
Denmark	Aarhus	3,706	3,071	8,492	11,563
Portugal	Lisbon	1,063	5,127	5,776	10,903
Norway	Oslo	3,737	1,162	9,506	10,668
Latvia	Riga	3,716	723	8,487	9,210
Estonia	Tallinn	3,716	1,114	7,405	8,519
Lithuania	Klaipeda	3,716	3,463	3,137	6,600
Ireland	Dublin	2,868	524	2,431	2,955
Iceland	Reykjavik	3,787	0	295	295
Total			936,207	953,012	1,889,219

Notes: 1. Distance Saving is when NSR is used. Obtained from Lee et al (2011), pp. 70-73.

Source: Container throughput for 2013 is obtained from Customs Korea trade statistics database

Korea's total container cargo throughput with Europe-17 in 2013 was 1,889,219 TEU (936,207 TEU for export and 953,012 TEU for import). The largest container throughput of the year was with Russia, in total 790,432 TEU (446,470 TEU for export and 343,962 TEU for import), followed by Germany with 397,971 TEU (194,071 TEU for export and 203,900 TEU for import) and the Netherlands with 229,843 TEU (103,496 TEU for export and 126,347 TEU for

import). The container volume of Europe-17 is equivalent to 77.1% of the total Korea-Europe container throughput in 2013: 74.2% of the export and 80.3% of the import, respectively.

The maximum number of possible voyages are presented in Table 6 by the various class of vessels, depending upon the duration of NSR opening for the navigation, given the container cargo throughput in 2013 against which a pro-rata technique of benching marking is used. It is assumed that the entire cargo throughput between Korea and Europe will be transported via NSR, substituted away from the conventional Suez Canal route and also that using NSR is sufficiently economical for both vessels operators and cargo owners. Three different regional groupings are used. First, Korea's trade with the entire European countries including Russia is considered. Although countries located south east of Italy may not be able to benefit from the opening of NSR, this particular regional grouping has been made for the purpose of a benchmark comparison. The second group refers to those 17 European countries (Europe-17) including Russia which would benefit the most from the opening of NSR. The last regional group includes only the top seven countries (Europe-7) in terms of the total throughput of containers cargo in 2013: Russia, Germany, Netherlands, UK, Belgium, Poland and France. These seven countries account for almost 94% of the total container cargos throughput bound to and from Europe-17, thus approximately accounting for 72% of the container volumes in Korea-Europe trade in 2013.

Four different vessels sizes are considered, despite several contentions with respect to the vessel size suitable for NSR navigations. Arguments are that most of the NSR is deeper than 20 meters but vessels over 4,000TEU are unsuitable for transiting on NSR due to some part of routes having a depth as low as 8 meters. For example, in Proliv Sannikova the draft is 13 meters, and in Proliv Dmitriya Lapteva it is only 8 meters (Liu and Kronbak, 2010, p. 441). However, Pohang City (2014) considers that a 5,000TEU class vessel would be suitable enough for NSR navigation. Lee et al. (2011) argue even further that potentially an alternative route on NSR, instead of the incumbent ones, could be explored with an increase of transit volumes, thus enabling vessels as big as 8,000TEU Post-Panamax Plus class to navigate through it. Therefore, in this paper, we assume that the maximum size of vessel would be 8,000 TEU.

If NSR is to become completely ice free and available for the navigation all year round, total voyages will vary between 2,725 and 3,769 for a 650TEU DAS class vessel, subject to the region groupings, while the corresponding figures for a 5000TEU Post-Panamax class vessel will be between 355 and 490 voyages. However, should NSR be open for three months only, which is currently considered as a more plausible scenario, the number decreases to 682 voyages for Europe-7, and it will marginally increase to 727 for Europe-17. The corresponding figures for a 4,300TEU class vessel for all year round NSR navigation amount to between 412 and 570 voyages by the regional groupings. With the 3-month opening of NSR, Europe-7 will have 103 voyages while Europe-17 and the entire Europe countries will have 110 and 143 voyages, respectively. For the largest sized vessel of 8,000 TEU capacity considered in this paper, Europe-7 will enable 56 voyages under the assumption of a three month openings of NSR and 222 voyages for navigation all year round.

Table 6: Maximum Voyages Possible for Korea-Europe Trade via NSR

Regions	Europe			Europe-17			Europe-7		
	All Year	3 Months	6 Months	All Year	3 Months	6 Months	All Year	3 Months	6 Months
Throughput Container Cargo (TEU)	2,449,539	612,384	1,224,769	1,889,219	472,305	944,610	1,770,920	442,730	885,460
Vessel Class (TEU)	No. of Voyages			No. of Voyages			No. of Voyages		
650 ¹	3,769	943	1,885	2,907	727	1,454	2,725	682	1,363
4,300 ²	570	143	285	440	110	220	412	103	206
5,000 ³	490	123	245	378	95	189	355	89	178
8,000 ⁴	307	77	154	237	60	119	222	56	111

Notes: 1. Double-Acting Ship (DAS) (Han, 2011); 2. Panamax (Kronbak and Liu, 2008); 3. Post Panamax (Pohang City, 2014); 4. Post-Panamax Plus (Lee et al., 2011). 2. Europe-7 are Russia, Germany, Netherlands, UK, Belgium, Poland and France

IV. Conclusions

The once ice-covered Arctic waters which are melting at an unprecedented rate have brought about many countries that are directly involved in the region to willingly become members of the Arctic council and/or others in order to participate in the global polar game of capitalizing on the opportunities. The opportunities presented include sustainably developing the untapped natural resources of the Arctic region and using the northern routes, especially the Northern Sea Route, for shipping. Korea which acquired an observer status in 2013 shows a strong interest in utilizing NSR for the shipping purposes, given that Korea's total trade volume with Europe in 2013 was US\$144.6 billion: US\$69.2 billion for exports and US\$75.4 billion for imports, while with the EU and Russia, the total trade were US\$105.1 billion and US\$22.6 billion, respectively. The corresponding total throughput of container cargo between Korea and Europe in the same year amounts to 2,448,539 TEU for the entire European countries, 1,490,696 TEU for the EU, and 790,432 TEU for Russia. The rapid expansion in the volume of trade between Europe and Korea which is expected to increase further, was in part due to the Korea-EU Free Trade Agreement which came into force in 2011, and also in part to Korea's sustained effort to diversify the sources of natural resources import, away from the high reliance on the incumbent suppliers. Such an expansion in trade with Europe and also the expectation of Arctic resource development will urge Korean shipping companies to further contemplate on the transshipping of the throughput containers via NSR. Our analysis of the number of voyages possible for the 2013 container cargo throughputs for Korea's trade with 17 European countries (Europe-17) including Russia indicates that over 2,900 voyages are possible via NSR when using a 650TEU DAS class vessel if the Arctic waters become completely ice free and open for navigation all year round. Over 2,700

voyages are possible for Korea's trade with the top seven European countries (Europe-7) of Russia, Germany, Netherlands, UK, Belgium, Poland and France. For the same size vessel, and in applying the more realistic assumption of the Arctic seas being navigable for only three months a year, the number of voyages reduces to 727 and 682 voyages for Europe-17 and Europe-7, respectively.

When the vessel size is bigger, the extent up to which navigation via NSR is plausible under the incumbent conditions, i.e. 4,300TEU and 5,000TEU class vessels, the number of voyages indicate 440~412 for the all year round opening of the route for the 4,000TEU vessels and 378~355 voyages for the 5,000TEU vessels. Under the assumption of NSR opening for only three months a year, the figures drop to 110~103 voyages for the Panamax class vessels and 95~89 voyages for the Post-Panamax class vessels.

It is, however, noted that these figures only indicate the maximum number of voyages possible under the very simplified assumptions that the entire transshipment cargos between Korea and Europe, in particular that with Europe-17 and Europe-7, will be substituted away from the conventional shipping route with Europe via the Suez Canal. Another contentiously remaining issue is whether the transshipment of container cargos via NSR will be actually economically viable. In spite of shortening the distance between Europe and Korea, numerous factors are involved in NSR navigation, which may potentially increase the overall transportation costs. Certainly, even if enough container cargo throughputs will be available for the shipment, the critical final decision on whether to transport via NSR will be made by the dynamic interactions of at least three stakeholders involved in using NSR. They are cargo owners, vessel operators and Russia.

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