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The future of arctic shipping business and the positive influence of the international code for ships operating in polar waters

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Shipping Safety

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Dalaklis, Baxevani, and Siousiouras summarize the current situation of Arctic shipping operations and convey the message that activities in the Arctic should follow a very strict procedural framework to ensure effective risk mitigation.

Who should read this paper?

This paper is mainly exploratory in nature and provides a review of the latest developments in relation to the Arctic. Academics and scientists who have an interest in Arctic affairs as well as practitioners within the extended maritime industry, seafarers, and maritime education and training faculty would find this paper of interest.

Why is it important?

Maritime traffic in the Arctic is expected to increase, especially when considering the issue of exploration/exploitation of energy resources in the wider region and the seabed of the Arctic Ocean. Considering this dangerous and harsh environment, raising the standards of safety and ensuring the right level of environmental protection are identified as the way to move forward. The paper also conveys the need that, along with building further experience in Arctic operations, changes and improvements to the current legislative framework should follow swiftly. It provides a very good opportunity to link both the oceans and the maritime communities towards a safer Arctic.

About the authors

Associate Professor Dimitrios Dalaklis joined the World Maritime University (WMU) in the summer of 2014, upon completion of a 26-year distinguished career with the Hellenic Navy. His expertise revolves around the extended maritime education and training domain and especially the conduct of navigation (regulatory framework, associated best practices, and related equipment), as well as safety and security issues. He is a Hellenic Naval Academy's graduate; his postgraduate studies took place in the Naval Postgraduate School of the United States (M.Sc. in Information Technology Management with distinction and M.Sc. in Defence Analysis). He then conducted his PhD research at the University of the Aegean, Department of Shipping, Trade and Transport. He is the author/co-author of many articles and studies in both Greek and English languages, with a strong research focus on Arctic related issues. His latest work (2018) *Trends and Challenges in Maritime Energy Management* is available by Springer International Publishing AG.

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THE FUTURE OF ARCTIC SHIPPING BUSINESS AND THE POSITIVE INFLUENCE OF THE INTERNATIONAL CODE FOR SHIPS OPERATING IN POLAR WATERS

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ABSTRACT

The International Maritime Organization (IMO) has paved the way for the shipping industry's safer future in the challenging waters of the Arctic (and the Antarctic) through the introduction of the International Code for Ships Operating in Polar Waters (Polar Code). With that Code as the epicentre of discussion, the initial findings of the analysis in hand were presented at the International Association of Maritime Economists' 2016 Conference. Considering that: a) a significant period of time has already elapsed since the Polar Code's initial adoption; b) the Code entered into force on January 1, 2017; c) the number of ships operating in the Arctic will certainly increase in the future, especially when factoring in activities related to the Yamal LNG (an integrated project encompassing natural gas production, liquefaction, and shipping) and the upcoming Arctic LNG-2 projects, it is now time to provide a necessary update. It is shared knowledge that the Arctic landscape is being transformed at an unprecedented speed; the scientifically recorded decline of ice coverage in the region is creating significant new business opportunities. Shipping activities are directly affected by the many ambitious energy resource exploration projects already underway, as well as the opening of the so called "Arctic Passages." A promise for shorter voyages from Asia to Europe and the Americas (and vice versa) is enticing; the decision, however, on whether to opt or not for one of these routes is complicated, with many varying aspects involved simultaneously. The answer regarding the economic viability of Arctic shipping is not yet fully understood and predictions for the near future indicate that even the most promising crossing, the Northern Sea Route, will remain of limited importance for the global maritime transport system. The Polar Code has certainly increased the level of safety for shipping activities performed in Arctic waters up to now; however, certain improvements/updates must be expected in the near future.

KEYWORDS

Polar Code; Arctic passages; Northern Sea Route; Maritime safety

INTRODUCTION

During the last couple of decades, many important environmental premierships were recorded, based on a significant improvement of the related "record-keeping"; unfortunately, the vast majority of them are far from desirable. It is indicative that, according to the World Economic Forum (during the whole time period covered by its reporting), 2016 was the first year that an environmental danger and more specifically, "failure of climate change mitigation and adaptation," ranked first above weapons of mass destruction, water shortage, prices of energy resources, etc. [World Economic Forum, 2016]. Climate change was considered to be merely a concern of the distant future, but changes in weather patterns are now recorded more and more frequently worldwide.

The Arctic region is used by climate scientists as an indicator for the course of events for the entire planet, as the specific region heats up with the greatest pace when compared to any other part of our world. During the 2017-2018 winter season, record high air temperatures – for the third year in a row – were confirmed by two principal U.S. based research centres monitoring climate behaviour: National Aeronautics and Space Administration and National Oceanic and Atmospheric Administration. January 2017 was the ninth consecutive month that these institutions monitored record high surface temperatures in the Arctic and March 2018 was the second

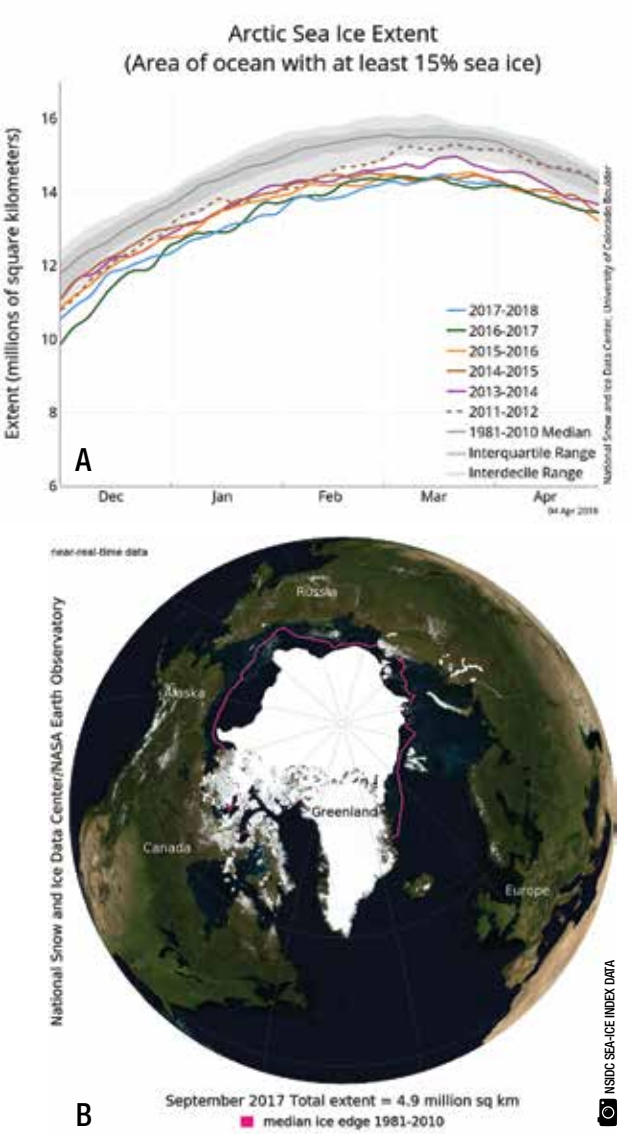


Figure 1 (A, B): Arctic sea-ice extent: (A) As of 4.4.2018 (light blue line), (B) October 2017 compared to median ice edge 1981 to 2010 (pink line).

lowest in terms of sea-ice extent since 1979 [NSIDC, 2018]. It is important to note that March is usually the month during which the maximum ice coverage is observed. So far, February and March were associated with a very low sea-ice extent; therefore, the ability of the sea-ice to endure the melting season is clearly compromised (see Figure 1A, B). In fact, the pace of Arctic sea-ice retreat is increasing and a decline of 9.3% per decade is established [NSIDC, 2017].

Having previously examined the multi-faceted geopolitical dimensions of the Arctic [Siousiouras et al., 2013; Dalaklis and Baxevani, 2016; Seker and Dalaklis, 2016; Drewniak et al., 2018], the future of shipping in the region will now be explored by providing an analysis of the primary maritime routes with an emphasis on the most promising one: the Northern Sea Route (NSR). Additionally, the influence of the International Code for Ships Operating in Polar Waters (Polar Code) upon ships operating in the Arctic will be discussed. It is clear that for the time being Arctic traffic sees significant variances in volume from year to year and hindrances persist, primarily in regard to the availability of icebreakers needed to keep these maritime corridors open and provide escort to transiting vessels [DeWitz et al., 2015; Dalaklis and Drewniak, 2017A; Dalaklis and Drewniak, 2017B; Drewniak et al., 2017; Drewniak and Dalaklis, 2018; Dalaklis et al., 2018].

The Russian interest to promote the use of the NSR [Humpert, 2017A] is not a coincidence; should the "Arctic Passages" become established as regular maritime routes, this would mean an upgraded economic posture for coastal states and their respective ports, offering shipping companies considerable savings of time and fuel (cost) in reaching certain destinations. Furthermore, the Arctic can offer a promising new field for innovation in various sectors of the maritime industry such as shipbuilding, tourism, and energy resource exploration and exploitation. While conditions for shipping operations in the wider region still remain harsh and perilous, the IMO has already taken a forward leaning approach toward the enhancement of maritime safety in the Arctic region with the introduction of the Polar Code on January 1, 2017. (IMO has adopted the Polar Code and related amendments to make it mandatory under both the International Convention for the Safety of Life at Sea (SOLAS) and the International Convention for the Prevention of Pollution from Ships (MARPOL). The Polar Code and SOLAS amendments were adopted during the 94th session of IMO's Maritime Safety Committee (MSC) in November 2014; the environmental provisions and MARPOL amendments were adopted during the 68th session of the Marine Environment Protection Committee (MEPC) in May 2015.) A discussion of the multi-facet regulatory efforts in relation to the Arctic will be provided; in addition, the argument that the introduction of the Polar Code was an action of top priority, even if today there is still room for improvement, will also be put forward.

ARCTIC AND THE SHIPPING INDUSTRY

Shipping is an industry strongly interwoven with the environment and as such it can be directly affected by the latest developments in the Arctic [Dalaklis, 2017]. The retreat of ice in the region is opening up new areas/routes for navigation. According to the latest scientific estimates, the days when navigation is possible are expected to follow an increasing trend: from around 70 days (currently) up to 125 in 2050 and as many as 160 in 2100 [Cariou and Faury, 2015]. Significant discussion has emerged on the potential profits/financial benefits the use of the "Arctic Passages" could yield.

It is necessary to note that for the analysis in hand, the "Arctic" is comprised by the Arctic Ocean and the territories within the Arctic Circle (latitude higher than 66°33′47.2″ North) which belong to five states, namely Canada, United States of America (U.S.), Norway, Denmark, and Russia [Dalaklis and Drewniak, 2018]. This is a very simplistic approach in terms of definition and should not be confused with the Polar Code's geographical scope, which is using a rather complex level of detail: *"Arctic waters means those waters which are located north of a line extending from latitude 58°00'.0 N, longitude 042°00'.0 W to latitude 64°37'.0 N, longitude 035°27'.0 W and thence by a rhumb line to latitude 67°03'.9 N, longitude 026°33'.4 W and thence by a rhumb line to Sørkapp, Jan Mayen and by the southern shore of Jan Mayen to the Island of Bjørnøya and thence by a great circle line from the Island of Bjørnøya to Cap Kanin Nos and thence by the northern shore of the Asian continent eastward to the Bering Strait and thence from the Bering Strait westward to latitude 60° N as far as Il'pyrskiy and following the 60th North parallel eastward as far as and including Etolin Strait and thence by the northern shore of the North American continent as far south as latitude 60° N and thence eastward along parallel of latitude 60°.N, to longitude 56°37'.1 W and thence to the latitude 58°00'.0 N, longitude 042°00'.0 W"* (see Figure 2A). Simplicity is used in the case of Antarctic; waters south of 60° S are covered by that scope.

In any case, the geographic position of three of the above mentioned states, Canada, Denmark (through Greenland) and Russia,

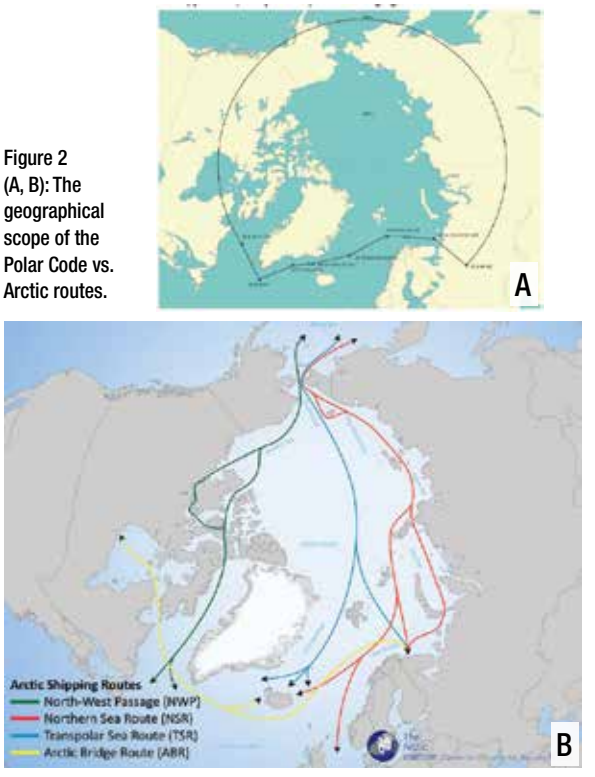


Figure 2 (A, B): The geographical scope of the Polar Code vs. Arctic routes.

MEPC 68/21/ADD.1ANNEX 10, PAGE 9; ARCTIC INSTITUTE-CENTRE FOR CIRCUMPOLAR SECURITY STUDIES, 2014.

offers an added advantage; apart from belonging to the very exclusive group of Arctic states, they are located adjacent to the emerging maritime corridors. In regard to Arctic navigation, it is necessary to highlight that the greatest interest is directed towards two different routes (see Figure 2B): a) Northwest Passage (NWP); b) Northern Sea Route (NSR), which are both intercontinental maritime connectivity alternatives.

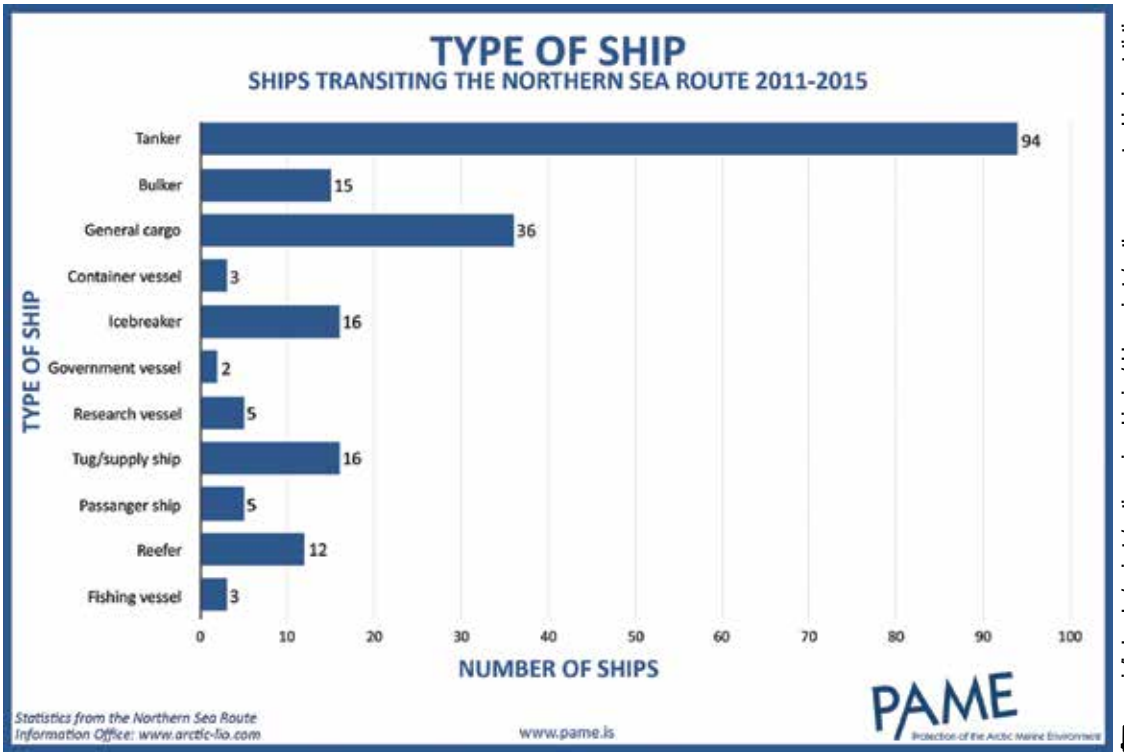
The importance of the NSR lies mainly in the fact that it can connect the Asian and European markets through the eastern part of the Arctic Ocean; it offers a very attractive alternative to the Suez Canal Route by reducing the respective voyage by approximately 40%. This could also lead to less pressure on the main transcontinental route currently in use (through the Malacca

Strait-Indian Ocean-Suez Canal) and allow for avoidance of regions prone to piracy, such as the Gulf of Aden [Dalaklis, 2012]. For states like China, Japan and South Korea, the NSR could also provide an alternative of using the extremely busy and congested Malacca. Apart from the Norwegian coastline, the great majority of the NSR (about 90% of the entire route) runs along the Russian coastline: from Novaya Zemlya west to the Bering Strait east. Because of this fact, legal complications arise, as there is regulation that commandeers this route under Russian jurisdiction: Council of People's Commissars of the USSR 17.12.1932. This also creates the necessity to pay a fee for the obligatory vessel escort by Russian operated icebreakers, and mandates the acquisition of a permit in order to cross.

It is apparent that the aforementioned obstacles limit the attractiveness of NSR and, as argued by third party states, pose a de facto limitation on the freedom of navigation. State sovereignty is in this way extended over waters where navigational freedom should apply and an established transit mode (innocent passage) becomes void [Gavrilov, 2015]. Furthermore, as long as there is a high icebreaker fee, the subject "Arctic Passage" is losing its economic attractiveness [Liu and Kronbak, 2010; Lee and Song, 2014]. Aiming to boost the volume of maritime traffic, the Russian state has for the time being simplified the bureaucratic procedure for issuance of a crossing permit, which used to be a major hindrance [Dalaklis and Baxevani, 2017]. Another important maritime traffic regulation to note is the "2012 Federal Law No. 132," adopted by the Russian State (Amendments to Certain Legislative Acts of the Russian Federation Related to the Governmental Regulation of Merchant Shipping in the Water Area of the Northern Sea Route). A broad "definition" of the NSR is provided there; the specific legal text also describes the prerequisites for crossing (permit and fee).

The Northwest Passage (NWP) links the Atlantic with the Pacific Ocean, through the Canadian Archipelago. Currently, this passage is interesting for the tourism industry (in 2016 the *Crystal Serenity* became the first luxury liner to cross with more than a thousand people on board; this activity was repeated in 2017, but not in 2018 [Dalaklis and Drewniak, 2018]. Certain cargo ships have also used this passage, though not in significant numbers. In general, cargo ships would have fewer limitations regarding their draft and width compared to the Panama Canal prerequisites. However, the geography along this passage is very complicated and rather troublesome for navigation.

However, drifting ice can block access to certain locations and entry/exit points, leaving narrow or shallow corridors open, which are unsuitable for large vessels. Additionally, Canada's small ice breaking fleet make it nearly impossible to deliver the same level of services as the Russian NSR related fleet [Drewniak et al., 2017; Drewniak et al., 2018]; there are also hardly any points along the way to pick up or drop off cargo [Rodrigue, 2016]. Because of these obstacles, a significantly smaller number of vessels are expected to cross the NWP when compared to the NSR.



pame.is/index.php/projects/arctic-marine-shipping/older-projects/northern-sea-route-shipping-statistics.

Figure 3: Ships transiting the Northern Sea Route 2011-2015.

Another seasonal passage of interest is the Arctic Bridge (AB), which connects the Canadian port of Churchill, the Norwegian port of Narvik, and the Russian port of Murmansk. For this option, it must be noted that as Greenlandic ice melts, the number of icebergs that can be encountered for vessels transiting the AB will be increased. Discussion of the Arctic routes also involves the Central Arctic Route (CAR) or Transpolar Route (TPR), which provides a "direct line" of passage across the Arctic Ocean. For the moment, the few voyages completed via this passage have been of an exploratory nature (scientific expeditions, testing of travelling times and use of equipment in extreme weather conditions) or for power projection reasons. For this route to be considered commercially viable, numerous changes must take place in regard to infrastructure, communications, emergency response, ice capable fleets and, above all, an extreme continuation of sea-ice decline [Dalaklis and Baxevani, 2017].

THE NORTHERN SEA ROUTE

As already pointed out, the NSR is the passage that has attracted the most attention and commercial vessel traffic in the Arctic thus far (see Figure 3); this fact will be further examined here. Presently, the primary cargoes being shipped along the NSR include energy resources (fuel), timber, equipment and various commodities including lots of raw materials. The aim of the Russian state is to further attract cargo shipments through the NSR; for this reason, it has invested heavily in shipbuilding and maritime infrastructure projects so as to enhance support of navigation (e.g., updated nautical charts, establishment of much needed search and rescue (SAR) centres) and logistics; and to

establish a land network that will connect NSR ports with other land based markets.

In Russia, there is an ongoing effort to optimize Arctic shipping operations; for example, an initiative headed by the governor of the Arkhangelsk Oblast aims to establish an institute that would coordinate logistics operations along the NSR. In respect to the "transportation of supplies to state customers in the Arctic," if implemented effectively, such a coordination centre could drastically shorten delivery times to customers while simultaneously reducing expenses [Pettersen, 2016]. The designation of a few "special support zones" has also been suggested (by the Russian deputy prime minister) as a means to facilitate and enhance development of the Russian Arctic [Staalesen, 2016A].

For the time being, general cargo shipments are primarily focused on regional needs (terminal and not transit traffic [Lasserre, 2012]) and it is expected that this trend will continue through the foreseeable future. Local oriented shipping operations are usually conducted by ships under the Russian flag (with old, but still capable ice-strengthened vessels; these activities are often conducted without an escorting icebreaker during the so-called "warm season"). In addition, the direction of the cargo is rather unbalanced, since return voyages generally only carry ballast [Humpert, 2014].

An area of increasing importance is the partnership formed to materialize the Yamal project [Gabuev, 2015]. Launched at end of 2013, the Yamal Project is one of the most complex liquefied natural gas (LNG) projects ever undertaken. Located above the Arctic Circle and in a region that is ice-bound for seven to nine months during the year, Yamal is isolated from the necessary logistics infrastructure. LNG tankers with icebreaking capabilities, specially designed for the project, will ship LNG to international markets through the NSR. (See Total, "Yamal LNG: The Gas that Came in from the Cold," at: www.total.com/en/energy-expertise/projects/oil-gas/lng/yamal-lng-cold-environment-gas.) Since 2015, the vast majority of NSR traffic volume is associated with the Yamal LNG project. Transport of LNG is expected to generate additional vessel traffic through the NSR when the Yamal project is in full swing, or when new LNG projects – such as Arctic LNG-2 – are operationalized. Furthermore, apart from the latest developments ashore, the Russian Exclusive Economic Zone is estimated to hold very large energy resource deposits; after extraction, maritime transport via the NSR will bridge the gap towards the final consumer.

Cargo traffic volume in NSR experiences significant fluctuations, considering that it can be influenced by a number of economic, political, seasonal, and geopolitical factors. The motives behind Arctic traffic apart from pure economic are quite often politically motivated [Lee and Song, 2014]. A maritime presence in the region is important for any state that wishes to be involved in future developments. Regional unrest can greatly influence vessel traffic numbers and infrastructure projects as demonstrated by the Ukrainian crisis, a repercussion of which was the withdrawal of western funds. For Russia, further strengthening its partnership with China is a suitable alternative in order to replace these funds [Stulov, 2015].

Apart from these "domestic" explanations, current traffic volume in the Arctic can further be explained by the overall structure of the shipping sector. Containerships are the backbone of contemporary maritime transport and they are reliant upon predictability and accuracy [Corbett and Winebrake, 2008] – conditions that the Arctic passages can by no means provide [Schøyen and Bråthen, 2011]. When it comes to cost, studies have concluded that the cost for containerships to use the NSR is "not prohibitive" and therefore could accommodate some traffic of this type in the future [Verny and Grigentin, 2009]. However, it is not possible to completely eliminate the possibility of unpredictable deviations due to ice floes and blocked passages. For this reason, dry bulk and local commodities traffic are expected to take up the majority of the volume [Rodrigue, 2013].

Additionally, because of the aforementioned LNG projects, the number of ships interacting with NSR ports is likely to increase, which could also influence their future expansion [Rahman and Rasdi, 2014; Humpert, 2017B]; yet, all of these ports combined are nowhere close to the major hub volumes (e.g., Singapore). Currently there are 17 ports along the NSR and icebreaking services grant uninterrupted access to the majority of them [NSR Administration, 2016; Dalaklis and Baxevani, 2017].

REGULATING ARCTIC SHIPPING TO ENSURE ITS SAFE FUTURE

The characterizations "Arctic Mediterranean" [Henrikson, 1992] or "emergence of an Arctic economic rim" [McGwin, 2016] are very revealing in regards to expectations. On the condition that the current reduction of ice coverage continues, ships will have the option of an "Arctic Passage" in addition to the traditional maritime corridors through the Indian Ocean-Suez Canal and the Pacific Ocean-Panama Canal. Arguably, however, concerns are also rising regarding the use of these passages, given that the existing infrastructure, communication capabilities, and the overall ability for emergency response are far from satisfactory.

The existence of adequate SAR centres and their performance are points of concern; more surveillance and communication systems are also necessary. Nautical charts are currently being updated, yet they cannot possibly contain accurate information regarding drifting floes; a dedicated service for monitoring and informing transiting maritime traffic on obstructing ice floes seems appropriate, and may be necessary. Traffic may indeed be expected to increase [Dawson, 2014; Dalaklis et al., 2018], but for the time being navigational conditions remain challenging even during the summer months. Safe Arctic shipping requires technological advancements and substantial funding for infrastructure.

On the positive side, the distinct characteristics of the polar areas and the need for pre-emptive safety measures before any major catastrophe occurs has been realized by a very prominent institution for maritime affairs: the IMO. The organization's main tasks include developing and maintaining a comprehensive regulatory framework for shipping; with the introduction of the International Code for Ships Operating in Polar Waters (Polar Code), the IMO has

identified and began to address a pressing need for specially trained crews and improved shipbuilding practices for the Arctic region. The Code is divided in different parts covering mandatory measures on safety and pollution prevention, as well as recommendatory provisions for both.

The Polar Code entered into force on January 1, 2017, and it imposed the requirement for ships intending to operate in the defined waters of the Arctic and Antarctic to apply for a Polar Ship Certificate. The issuance of the certificate requires an assessment taking into account the anticipated range of operating parameters and hazards the ship may encounter in the polar waters. The Polar Code also introduced certain training requirements for seafarers (depending on their position/duties on board the vessel), with various courses already offered by training centres. It is also important to note that a grace period for transitional arrangements was used to facilitate the smooth introduction of the new system for certification [Dalaklis and Baxevani, 2015]; however, that period has now elapsed. (Chapter 12 of the Polar Code on manning and training states that "Companies must ensure that masters, chief mates and officers in charge of a navigational watch on board ships operating in polar waters have completed appropriate training, taking into account the provisions of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) and STCW Code." These minimum requirements (training and qualifications) are mandatory since July 1, 2018.)

In relation to safety, maritime accidents in Arctic waters have already occurred (see Figure 4); luckily, there has yet to be a major accident. Having said this, significant concerns remain that the existing ice capable vessels operating in the Arctic [Kiiski, 2015] cannot satisfactorily cover all operating areas. It must also be stressed that survival time in these waters is well below the respective time for warmer areas. Unless there is a ship in very close proximity, casualties would be a certainty. This is a matter of great importance notably for the cruise ship industry (which involves a large number of passengers each voyage) as well as the oil industry, since rigs are already operating in the area. (Of particular interest, often considered as a wake up call for further regulating activities within polar waters, is the story of MS *Explorer*. It was the first cruise ship used specifically to sail the icy waters of the Antarctic Ocean, and the first to sink there, when she struck an unidentified submerged object (ice) on November 23, 2007, that caused a gash in the hull. On the positive side, all passengers and crew were successfully rescued. However, considering that after abandoning the ship, they boarded open lifeboats, they were extremely fortunate that weather conditions remained relatively benign and that the Norwegian ship *Nordnorge* was within four hours of their position. Had it not been the proximity of that vessel, the survival of the *Explorer*'s passengers and crew would have been in grave doubt [Snider, 2018].) While rescue exercises have taken place to test response capabilities, thus far these exercises have all been located relatively close to the coastline. As new sea areas become available, distances between the events and the response centres are going to increase dramatically.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Machinery damage/failure	5	13	14	16	12	13	20	27	46	32	198
Wrecked/stranded	10	11	14	9	9	8	10	14	6	11	102
Miscellaneous	5	1	4	4	2	6	5	5	6	4	42
Collision		1	4	10	4	4	2		3	2	30
Fire/explosion	3	1	2	6	6	1	4	2	4	1	30
Contact (e.g. harbor wall)	1	1	1	3	1	3	6	4	5	1	26
Hull damage	3	1	6	2	2	1	2	1	1	2	21
Foundered	1	1	2		3	1	1	2		1	12
Labor dispute										1	1
Total	28	30	47	50	39	37	50	55	71	55	462

Figure 4: Casualties (shipping incidents), including total losses in Arctic Circle Waters, 2007-2016. Credit Lloyd's List Intelligence Casualty Statistics Data Analysis and Graphic: Allianz Global Corporate and Specialty at AGCS Safety Shipping Review 2017, p. 25. Data as of March 6, 2017.

According to the table in Figure 4, 462 incidents were reported in the Arctic region between 2007 and 2016, with machinery damage or failure being the cause in the majority of the cases (60%) showcasing the impact of the harsh conditions. It is also noted that over a third of those involved fishing vessels [Allianz, 2017]. Regarding total vessel losses for 2016, two were recorded in the Canadian Arctic and Alaska and two in the Russian Arctic and Bering Sea [Allianz, 2017]. With more traffic being expected in the Arctic region, the need for a sound SAR framework seems essential.

Maintaining a high level of safety in the Arctic can be achieved only by being proactive. Clearly, there is little margin for error or correctional measures, all the more so when it comes to environmental protection. A major oil spill would be absolutely devastating for the already fragile regional ecosystem. From a regulatory standpoint, the United Nations Convention on the Law of the Sea (1982) states that coastal states can pose restrictions and regulate traffic so as to protect the natural environment from pollution caused by ships, as defined by UNCLOS Article 234, titled "Ice-covered Areas." Therefore, certain "interventions" in that direction should be expected in the near future, especially when the respective maritime traffic volume will be clearly increased.

As already pointed out, the full implementation of the Polar Code was a very significant advancement for the safety of Arctic shipping. The Code identifies specific risks and actions needed to mitigate them; for instance, it regulates the "qualitative" characteristics of the crew. In the same context, amendments were also made to the International Convention for the Safety of Life at Sea (SOLAS), the International Convention for the Prevention of Pollution from Ships (MARPOL), and the International Convention on Standards of Training, Certification and Watchkeeping (STCW). The aim is to provide sufficient enforcement tools that will further enhance safety and environmental protection.

The Arctic Council (AC) is another institution that is prevalent in Arctic affairs. It was established as an intergovernmental forum in

1996 and it has eight member states: the "Arctic five," plus Finland, Iceland and Sweden. Its goal is to facilitate communication and cooperation among Arctic states in dealing with environmental protection, sustainable development initiatives, SAR operations, and a variety of other regional issues. (More details and a description of work currently underway can be found at https://arctic-council.org/index.php/en.) Despite poor performance reviews from its critics, it has made an important contribution in the development of doctrine which will help establish a coordinated framework for Arctic navigational safety and environmental protection. Specifically, the Agreement on Cooperation on Aeronautical and Maritime Search and Rescue as well as the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic are key legislation which will help guide and unify Arctic member states approach in dealing with a wide range of critical regional issues [Drewniak and Dalaklis, 2018].

A study by Lindstad et al. [2016] noted that although it is common to associate Arctic routes with fewer CO_2 emissions, it points out that other harmful by-products which result from shipping (e.g., aerosols) are ignored and unregulated. It concluded that there are essentially no environmental benefits gained. In fact, environmental regulations and compliance to the Polar Code is another factor and a potential barrier to be considered by companies who wish to opt for polar routes; managerial intentions seem to be a major variable. The issue of ship owners' intentions as a pivotal aspect for the determination of voyage routes has been the subject of multiple studies. An interesting study conducted by Lassere and Pelletier [2011] involved 142 shipping companies, and examined their decision making criteria for choosing voyage routes. The 98 answers revealed "a lack of enthusiasm for Arctic shipping." Despite these findings, traffic associated with the exploration of natural gas in the Arctic (LNG shipments) will clearly intensify in the years to come.

In any case, what is now evident is that developments in the Arctic are not motivated purely by profit. For this reason, third party actors are actively pursuing involvement in Arctic development initiatives; this is confirmed by the AC permanent observer status acquired in 2013 by European and south Asian states [Jakobson and Seong-Hyon, 2013]. This point was further confirmed by the travel of a Chinese vessel (COSCO's *Yong Sheng*) through the NSR only a few months after China's accession to the Arctic Council as a permanent observer. Non state actors, such as the International Association of Oil and Gas Producers, also strive for participation. This signifies the critical importance of Arctic affairs not only regionally, but also on a global scale.

WHY HAS ACTUAL TRAFFIC VOLUME FAILED TO MEET OPTIMIST FORECASTS?

For the time being, the downsides of endeavours in the Arctic look greater than any potential advantage. In terms of commerce, there are not as many ports along these routes where shipments can be dropped off and picked up. Insurance costs are considerably

more expensive and highly customized (premiums, fluctuation). Because of the increased dangers of operating on Arctic routes (weather conditions, polar darkness, ice floes, lack of emergency response capabilities, etc.) P&I groups are less willing to provide coverage to ship owners who operate in these regions [DeWitz et al., 2015].

Further exacerbating the negatives of Arctic operations is the fact that in order to cross the NSR it is usually necessary to have an icebreaker escort. This escort is provided by the NSR Administration for a significant fee, further increasing costs. While the "Arctic Passages" can indeed offer shorter alternatives in comparison to the standard routes that today serve the maritime transport industry, it must be pointed out that fewer nautical miles do not necessarily translate into less overall cost due to shipbuilding costs. Transit speeds, permitting challenges, greater insurance costs, escort fees, and a variety of other factors must all be considered [Liu and Kronbak, 2010]. Various studies have tried to examine the profit potential of the routes, but results are inconclusive, since cost/profit is dependent on many variables (operation cost, fuels, speed, etc.).

Another factor to consider in examining Arctic route feasibility is that although overall CO_2 emissions may decrease (less nautical miles), regional emissions will undoubtedly increase and emission residues will become trapped in ice, causing it to darken and absorb sunlight rather than reflect it. This cycle results in ice melting more quickly and is already a major contributor to Arctic ice cap retreat. More vessel traffic also increases the potential for spills, along with concerns related to ballast water. Despite the numerous aforementioned challenges, Arctic exploration and shipping also open up new fields for innovation when it comes to shipbuilding, deep sea drilling technology, survival equipment, oil spill response and recovery, environmentally friendly fuel, and many others.

CONCLUSION

Among the numerous repercussions of climate change, the staggering retreat of Arctic sea-ice is among the most disconcerting. This seemingly devastating reality for the natural environment simultaneously opens up a window of opportunity for economic profits. Fisheries, tourism, and natural resource extraction are industries that expect to benefit from significant revenues. It is the shipping industry, however, that is presented with the most daunting challenges and perhaps stands to reap the most significant benefits. Not since the openings of the Suez and Panama Canals has this industry seen such transformative changes with the potential to introduce a new era to shipping.

Through the "Arctic Passages," an alternative way is offered to connect Asia with European and North American markets. Currently, the route that attracts most attention is the NSR. Traffic has increased significantly on the NSR and the stated goal of the Russian state is to promote the use of this route so as to assist Russia in re-gaining the highest levels of Soviet era global economic influence and power. In order to meet this objective and make the NSR more appealing to the shipping

industry, it has invested significant funding in the region to build port infrastructure, additional icebreaking capabilities, enhanced aids to navigation, and created better access to inland customers. Despite Russia's significant efforts, substantial delays in the development process have occurred. These delays can in part be attributed to the harsh environment in which they are working. Additionally, certain economic adversities, including heavy sanctions imposed by the West, have drastically slowed progress.

While the NWP and NSR have both attracted attentions from much of the academic and business world, their contribution to global maritime traffic volume is still very limited. Although using the "Arctic Passages" may decrease the total number of nautical miles a vessel needs to travel to reach its desired destination, a concrete determination in regard to the extent of cost savings to the maritime industry is to this point inconclusive and more research is clearly needed. Harsh environmental conditions, long distances without support, challenging shipbuilding and equipment requirements; any of these alone is very difficult to overcome and may nullify the advantage of the voyage distances these "Passages" can provide.

The lack of transport infrastructure, the necessity for specialized training and equipment, and sub-optimal emergency response capabilities are only a few of the variables that severely hinder the integration of the "Arctic Passages" as viable and lucrative global trading routes. Availability of funds, ship owners' intentions, and future regulatory framework in relation to energy resource extraction compound the complexity of maximizing the potential of these "Passages" for shipping. As the maritime transport industry hastens its future plans about how to exploit the Arctic region and its resources, emergency preparedness systems and response capabilities available to respond to human and environmental catastrophes must be further developed. For the time being, there are vulnerabilities in the capabilities of certain countries within the Arctic region to support safe and secure shipping operations and/or viable development opportunities; further research and intensive capacity building efforts will be needed in order to alleviate those weaknesses. In fact, the current state of readiness to respond to incidents related to health emergencies, SAR operations, and oil spill response is largely untested. A series of training exercises is posing as an action of priority, with simulation also providing a credible alternative in order to keep associated costs down [Bauldauf et al., 2016].

On the positive side, safety of navigation in the Arctic is greatly enhanced via the legally binding instrument of the Polar Code, which has recently been adopted by the IMO. In addition, the Polar Code is already supported by recent amendments to other specialized international conventions, namely the Standards of Training, Certification and Watchkeeping (STCW), the International Convention for the Safety of Life at Sea (SOLAS), and the International Convention for the Prevention of Pollution from Ships (MARPOL). The Polar Code is indeed a forward looking step in the right direction, but further improvements and continuous updates will most certainly be required. As shipping

operations continue to expand in the Arctic, invaluable experience and extracted knowledge will be gained; the associated lessons learned must be freely shared and communicated throughout the maritime community.

While the Polar Code has undoubtedly raised the safety standard for ships operating in extreme Arctic conditions, the fragility and ever evolving landscape of the polar ice caps will mandate that all related regulatory doctrine undergo continual review and updates. Only through the unbridled communication of Arctic experiences and the careful examination of lessons learned will we be able to better prescribe regulatory measures that will maximize protection of the Arctic environment while minimizing risk to the seafarers who travel upon its waters.

In addition to economic viability, there is significant interest in the Arctic from a geopolitical perspective. For example, militarily the region offers a unique strategic position for exercises, research, and intelligence gathering; for these reasons, it is likely that the Arctic will also see an increase in non-commercial vessel traffic in years to come. Apart from the United States of America, Canada, and Russia for obvious geographic and political reasons, the "Arctic Passages" are appealing to states having a significant maritime presence including China, Japan, South Korea, and even India. Though not well acquainted to the polar environment, the integration of non-Indigenous nations into the development of the "Arctic Passages" could provide much needed resources and an external perspective that will further advance Arctic shipping.

Arctic shipping is a promising field for innovation and entrepreneurship and so long as there are navigable waters and a clear margin for profit, vessel traffic is bound to increase. Despite the endless economic, scientific, and technological possibilities that the Arctic can offer, the maritime community must understand that further development in this region must be done with the utmost consideration for safety and environmental stewardship. It is pivotal that sustainability constitutes an intrinsic aspect of regional development.

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