The Northern Sea Route, reality and prospects

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Abstract:
The increasing global warming of the Arctic Ocean is freeing up space ice-free shipping that promotes new shipping routes, particularly along the Russian coast and to a lesser extent across the northern Canadian archipelago. The recent operation by sea of the Russian Novatek gas liquefaction plant on the Yamal Peninsula is highly publicized. From summer traffic with icebreaker tankers specially designed for these unassisted ice trips, Russia is already aiming to extend it to the winter period with its fleet of powerful nuclear icebreakers under construction. Russia, for which the exploitation of Arctic resources is a national priority, intends to capture some of the traditional traffic in the medium term, particularly container traffic. But in reality, are the polar roads really usable all year round? If regular gas traffic to European and Asian ports is already a reality, is it unreasonable to think that structured traffic by the Northern Sea Route (NSR) can compete with conventional routes through the Panama and Suez Canal? From a seafarer’s point of view, the problem of transit through polar sea routes is not as simple as it may seem.

Keywords: Arctic, NSR, Russian Arctic, ice navigation, northern sea route.

1. Introduction

The Chinese company COSCO, the 3rd largest shipping company in the world, regularly sends its ships for summer transit along the Russian coasts, by the Northern Sea Route, or NSR\(^1\). Since the first crossing of the cargo ship Yong Sheng in 2013, the company has been increasing its number every year. It plans to carry out fourteen of them before the beginning of winter 2019 (Humpert, 2019a). Although the number is anecdotal in relation to the volume of vessels following the traditional route through the Suez Canal, it nevertheless represents a quarter of the number of non-specialized vessels that use this NSR annually in its entirety. Should this be seen as the beginning of an alternative to a traffic whose announced savings are real? Some may say that the recurring reference to Chinese ships sailing along the NSR is an indisputable way of admitting that China, a country that claims to be "almost Arctic", masters this polar shipping route claimed in its ambitious Silk Road program, known as the BRI\(^2\). We will study the arguments in favor of developing this route, which we will find more favorable to traffic to destinations linked to the exploitation of Russian hydrocarbons. In the light of a study carried out for the transit of a container ship of the French company CMA-CGM, we will see that many factors limit the often poorly quantified ambitions of the gains obtained by Arctic roads, particularly for on-time traffic\(^3\). Finally, despite the arguments put forward, we will see what initiatives are on the horizon to enhance the value of maritime routes through the Arctic.

We will focus our study on the Northern Sea Route (NSR) because it mainly concerns traffic from North Asia to Northern Europe, to which is added a real desire of the Russian State to develop it. The Northwest Passage, through the Canadian archipelago, is much less direct. Although less frequently used, Canada does not wish to develop this waterway, presumably for environmental reasons and because of a lack of monitoring and response capacity. (Fig. 1).

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\(^1\) The Northern Sea Route, or Northern Sea Route that runs along the Russian coast, begins in the Bering Strait and ends in the Kara Strait that separates New Zealand from the entire continent. With the rest of the route to Norway’s North Cape, this transit from the Pacific Ocean is called the Northeast Passage.

\(^2\) Belt and Road Initiative; Chinese development of both maritime and land routes that ensure the security of supply or transport arteries for goods to and from China.

\(^3\) Timely maritime traffic is that of container ships that are assigned to a regular line with well scheduled stops. The voyage or destination one concerns liquid or solid bulk cargo ships chartered for a variable destination and over a defined period of time.
2. Will the chronic summer reduction in the extent and thickness of the ice pack favor polar sea routes?

Global warming, which is two to three times higher in the North Pole than in the rest of the world, suggests that summer shipping will take place in the ice-free Arctic between March and November in the coming decades, particularly along the Russian coast. The period between November and March corresponds to the period of winter darkness beyond the 60th degree of latitude without solar radiation where the sea freezes to form the ice pack. No climate model considers the melting of the ice pack in winter, even if its winter reconstruction is not systematic, particularly in terms of thickness. Global warming has resulted in an accelerated reduction in the surface area of the sea ice, particularly in summer but also in winter. 70% of its area measured by satellite since 1979 would be lost at the end of the century. This summer decline is accompanied by a thinner annual ice pack with increasingly concentrated and reduced multi-year ice around the Pole.\(^4\). Through the smaller albedo\(^5\) effect due to the reduction in sea ice surface area, seawater temperature increases and contributes to changing the balances of ocean/atmosphere interaction that are beginning to show significant changes in global weather patterns. This retroactive loop self-propels these effects, which include low polar pressures (polar lows) that generate more intense and persistent storms observed more frequently in the Arctic Ocean over the past two decades. The reduction in the area of the pack ice favors ice-free areas where the wind can blow (fetch) for longer, creating a larger swell that mechanically breaks the pack ice more easily. The dynamic effects of storms increase the drift speed of the ice pack generate ocean waves that modulate the export of sea ice from the Arctic Ocean (Semenov, 2019).

These storm-induced changes can affect the distribution of sea ice. The modification of the low-pressure centers therefore favors an intensification of transpolar drift and sea ice exports through the Strait

\(^4\) Only 4% of the ice cap area is formed by multi-year ice compared to 61% 30 years ago (www.nsidc.org).

\(^5\) Albedo represents the percentage of light reflected from a surface in relation to the quantity received. Its value varies between 0% and 100% (or between 0 and 1). For example, seawater, which absorbs solar radiation well, has an albedo of between 5 and 10% while sea ice has an albedo of about 60%. In the absence of sea ice, the ocean absorbs more solar radiation and thus contributes to its own warming.
of Fram. The high-pressure ocean circulation of the Beaufort Sea \(^6\), which reaches the North Pole, causes a global drift of the pack, especially in summer during the break-up\(^7\), from the central Arctic Ocean to the coasts of Canada and Alaska. This general circulation promotes the release of ice along the Russian coasts and increases its accumulation in the northwestern part of the Canadian archipelago, particularly on the most direct route through the McClure Canal, which remains inaccessible during the summer. With thinner pack ice due to a shorter cooling period, sea ice becomes more fragile under the mechanical effect of winds and swells. The ice pack breaks up into more numerous patches (floes), favoring its drift.

Depending on the action of the wind and currents, ice patches can more easily become entangled in archipelagic straits and inlets, particularly by forming a plug. These ice pack also collide and overlap, forming ice concentrations several meters thick\(^8\) that even the most powerful icebreakers cannot break. These phenomena are found mainly along the coasts, making it very difficult for specialized vessels to advance. Contrary to what one might think, global warming amplifies the phenomena of ice drift, which at certain places and times of the year makes it more difficult to progress in the first-year ice pack. In addition to ice drift, it is difficult to detect it for ships. During the day, these pieces of ice pack are visible but at night and in poor visibility, radar detection becomes much more random. The principle of radar detection is to favor the detection of the freeboard of the floe if it is thick enough to the detriment of its surface. In terms of navigation safety, a reduction in speed is required to maintain the ability to maneuver around these pieces of drifting ice. These phenomena related to the drift of the ice pack are mainly observed off the islands of Eastern Siberia which can, depending on the year, represent a lock that requires the assistance of an escort icebreaker (fig. 2). This drift of the ice pack is one of the reasons why a reduction in speed is essential and which, in many cases, forces the ship to change its course according to the concentration of the ice. As a result, the calculations of time and distance savings by the NSR route compared to conventional routes are far too often optimistic.

\(\text{Figure 2 : ice concentration chart as of July 9, 2019 (orange, ice concentration > 7/10th)}\) 
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\(^6\) Beaufort's gyre.
\(^7\) Break-up is the phenomenon of melting of the ice pack, its dislocation and therefore its drift due to the wind and currents; in contrast to the ice jam, which is the freezing of the sea in the form of ice pack. We speak of annual sea ice if this cycle is renewed every year, otherwise it is multi-year.

\(^8\) This is referred to as “hummocked” ice, or compression crest (ice ridge)
3. Are the savings achieved by the NSR in the order of 30%?

While the announced time, distance and cost savings of around 30 to 40% on a route between Northern Europe and North East Asia have been widely publicized, the optimism of what technically appears to be the new “White Panama” must be moderated by the sailor who must use this route. Polar routes are only really interesting in terms of distance if the planned transits are from North China, South Korea to northern European ports. For container traffic from Singapore, one of the world’s largest ports, to the Mediterranean, transit through the Suez Canal remains the shortest.

The Northern Sea Route has the greatest potential to shorten distances between Europe and Asia, thus saving costs compared to the roads that use the Suez and Panama Canal. We are talking about the 30% rules: 30% gain in distance between Chinese ports and European ports, 30% gain in travel time, 30% gain in operating costs and bunker costs (fuel). These gains are to be qualified. They are only valid for a period of less ice, from 3 to 4 months of the year only, and only under the conditions that the ports served are those of Northern China and Northern Europe. And yet, the road is not completely ice-free until late summer, with the East Siberian Sea being the last to clear the ice pack. From mid-October, the ice pack forms again. This period varies from year to year. Current predictive climate models do not consider a release of sea routes in wintertime. NSR is becoming much less attractive, if at all, for time travel such as container transport due to the many limiting factors mentioned below:

- No commercial stopovers on transit in the Arctic Ocean;
- Few deep-water and poorly equipped refuge ports; most of the ports on the Siberian coast are no more than 12 meters deep;
- Many straits must be crossed with draught constraints, the shallowest (Sannikov Strait, across the islands of New Siberia, between the Laptev Sea and the East Siberian Sea) does not exceed 13 meters;
- Areas still poorly hydrographic; few recent charts in electronic format regulatory on ships;
- Navigation aids are less accurate and redundant; few differential and local positioning means (DGPS etc.);
- Inmarsat geostationary satellite communications are no longer usable at latitudes above 72°;
- Transit along the North-East road is subject to authorization and wide notice to the Russian NSR Administration is required, sometimes discriminatory;
- The escort of an icebreaker is almost mandatory for ships that do not have an ice hull allowing them to transit independently;
- The width of the convoy opened by the icebreaker is limited to 30 meters wide; the number of ships escorted is very limited per convoy;
- The cost of escorting an icebreaker in relation to summer transit is estimated at between $5 and $9 per ton, which is about the same as the overall cost slightly lower than that required by the Panama or Suez Canal (cost to be adjusted according to the length of escort by an icebreaker on the NSR);
- The NSR is only of interest for bulk traffic related to the exploitation of Russian hydrocarbon and mineral resources;
- Polar zones are not covered by standard insurance clauses and are subject to surcharges of up to 50% of the basic contract for a vessel unfamiliar with sailing in these polar zones;
- A lower transit speed due to drifting ice and changing weather conditions, which does not necessarily mean fuel economy, as a diesel engine is optimized to operate regularly at full load;
- The width of the channel left by a current escort icebreaker does not exceed 30 meters limiting the size of the vessels (maximum for 100,000 tons cargo ships and 5000 TEU Panamax class container ships);
- The need to protect sensitive goods from the cold is a constraint for shippers, particularly containers.
- The very strong militarization of the Russian Arctic space for the purpose of securing control of the NSR could be interpreted as an area of potential tension by the shipping world.

In the summer of 2018, the two major Danish container transport companies Maersk and French CMA-CGM commissioned several 2600 TEU Ice Class 1A container ships on the Baltic Sea routes (Figures. 3 and 4) to provide a regular service between Northern Europe and the port of St Petersburg.

9 The Panamax standard is 32.2m wide, which corresponds to the width of Panama’s old locks, i.e. a 5000 TEU container ship - Twenty foot Equivalent Container or TEU.
After leaving the Asian yard, Maersk successfully transits the *Venta Maersk* via the NSR. CMA-CGM had considered making the same trip, but the cost study\(^\text{10}\) concluded that the gains envisaged by favoring transit via the NSR were not substantial enough compared to the conventional route through the Suez Canal. With the company’s concern to preserve the environment, this is one of the reasons why the trip by the NSR was postponed\(^\text{11}\).

The upstream study covered a voyage in September between the site in Pusan, South Korea and Zeebrugge, Belgium. The optimal ice conditions assumed at that time made it possible to calculate the transit by direct route through the northern New Siberian islands in the Laptev Sea, the Vilkitski Strait between the mainland and the Severnya Zemlya islands and finally north of the New Zemlya (Novaya Zemlya) in the Kara Sea. This great circle route\(^\text{12}\) may suffer from some variations depending on the ice conditions encountered, but without significantly altering the distances travelled (Figure 5).

\(^{10}\) The synthesis of the study was carried out by the author with the collaboration of the CMA-CGM, which kindly provided the data and validated the attached tables. Study carried out between November 2018 and April 2019.

\(^{11}\) At the end of August 2019, CMA-CGM declared that it would exclude the transit of its ships via polar maritime routes in order to preserve the environment, which has become fragile due to global warming. The 4th largest container carrier in the world is at the forefront in this area and has planned to acquire 20 LNG-powered PCs by 2022.

\(^{12}\) The orthodromic route (great circle route) is the shortest route travelled on the earth’s sphere and is represented in a curve on a Mercator projection plane map, unlike the loxodromic route which is a straight line on the same projection. To better realize that the orthodromic route is shorter than the loxodromic route, it is necessary to look at the routes traced on the sphere or on a map in polar projection (figure 1).
The study concerns a 195-metre-long Panamax container ship, 32.2 meters wide, with a displacement of 34,500 tones and a capacity of 2,600 containers (TEUs). The ship's Ice Class 1A is the highest of the Summer Class that can theoretically progress through first-year ice less than one meter thick in summer (Baudu.H, 2018).

It is not strictly speaking an icebreaker that can operate all year round in thicker ice and very low temperatures. The CMA-CGM Pregolia is limited, in particular because of the nature of the goods, transported in containers, which are sensitive to cold. The unit cost of building the ship is $38 million. The additional cost is about 10% compared to a ship of the same capacity without Ice Class 13. This mainly concerns a larger hull sampling, a propeller with reinforced blades and additional devices related to the ship's operation at very low temperatures. To this must be added the regulatory provisions of the Polar Code (specific equipment, deck officer training - $97,500 in our study). These additional costs are not voluntarily included in the comparison because they are part of the ship's initial investments (CAPEX) that can be amortized over several years and not in its operation (OPEX). They could be reflected in the amount of the daily charter cost, but it must be noted that the rates for this type of container ship are very little affected by Ice Class 1A. This is the reason why the charter price is the same in the comparative table. This table in Figure 6 details the comparison of the costs of a trip between the same ports, one by the Northern Sea Route and the other by the traditional Suez Canal route. The time difference is related to the shorter distance covered by the NSR, 2,800 miles of gain which translates into 9 days at a speed of 12.5 knots.

Speed is an average speed that is easily controlled by the conventional route where all the organization of ports of call and passage of the Suez Canal are set to the nearest hour. The speed of 12.5 knots is calculated in particular according to the desired fuel consumption. Due to the high cost of fuel, this speed is called economical. On the other hand, maintaining a regular average speed is illusory by the NSR. The ice conditions encountered will have a direct impact on the modulation of the speed, they will be weak to slalom between the pack of drifting ice, and higher in open waters to catch up in order to maintain the

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13 By way of comparison, the 17,600m3 LNG ARC 7 Yamal Max tankers cost $320 million per unit for a series of 15 vessels; a conventional LNG tanker with similar loading capacity, known as Q-Flex, costs $270 million, or 15% less expensive.
imposed average. In many cases, it will also be necessary to adjust the speed, or even stop to wait for the arrival of the pilot and/or escort icebreaker, which may not be available at the time the vessel wishes to proceed in the ice-covered areas. These variations in speed generate higher consumption\textsuperscript{14}.

For insurance related to this portion of the voyage via the Arctic Ocean, an additional premium is required for both ship and cargo insurance. A bulk ship will be insured for the voyage while the container ship will be insured for its charter period, usually several years. Ships benefit from universal insurance from the moment the voyage does not exceed 60 degrees of latitude. Beyond that, as in critical areas (piracy, war, the Straits of Hormuz at present, etc.), an additional premium is required for the additional risks that the ship may take during its transit (waterways by collision with ice, machine damage due to cold weather, difficult management of accidental pollution, lack of emergency towing facilities in the event of damage, etc.). The amount of the additional premium is calculated based on many criteria that may vary according to the duration and period of transit in the polar zone, the ship's ice class, the ship's seniority, the crew's experience, etc. In any case, the insurers will want to have the guarantee that the ship will transit with the approval of the NSR Administration (NSRA), the certainty of obtaining assistance from an icebreaker escort in the event of immobilization in the ice and the presence of a pilot throughout the areas in which his presence is required. This requirement of insurers, who have very little perspective on accidents to be compensated in the polar zone, is an essential point in favor of Russian traffic control along the NSR. Indeed, companies, whatever the type of goods, will not oppose NSRA's requirements, even if they may be interpreted as abusive under international maritime law. This additional premium is extremely variable and can represent between 10 to 50% of the value of the standard premium; however, it remains marginal compared to other transit costs.

Whether it is for the classic route through the Suez Canal or the NSR, pilotage is compulsory. Theoretically, the NSRA only requires a pilot and escorts an icebreaker based on the ship's Ice Class, the areas crossed and the transit period. The NSRA website allows the ship's requirements to be quantified according to these criteria. In our study, it was decided to use the assistance of a pilot in areas 3 to 7, those areas most likely to encounter ice floes. Again, these choices are extremely random and time-consuming because the availability of pilots and icebreakers at the desired location is not guaranteed. The Venta Maersk chose to take a pilot before crossing the Bering Strait and disembarking him at Murmansk, which lengthened his transit. All these provisions mean that the costs of pilotage by the NSR are generally higher than those by the Suez Canal.

Finally, the most important point is the fuel used. Cargo ships are powered by 2-stroke slow diesel engines that are designed to operate normally on heavy fuel oil (HFO) at a significantly lower cost than diesel (MDO) which emits less Sulphur. In some restricted areas such as Northern Europe or the United States, ships must switch to the MDO to reduce pollution. Although still unregulated, the Arctic Ocean is vulnerable and ethically some shipping companies choose to use MDO or gas to reduce environmental impact. This virtuous constraint imposed by CMA-CGM and Maersk on themselves to consume diesel throughout the NSR has a very significant cost. Comparing the costs of HFO on the conventional route and MDO on the NSR, we can see that the economy is no longer so significant when using polar routes. Figures 7 and 8 show the breakdown of costs according to the route chosen.

\textsuperscript{14} The consumption varies with the cube of the speed. A speed of 16 knots instead of 12 generates three times more fuel consumption. Slow speed is also not desirable for slow diesel engines, which become dirty and therefore consume more fuel.
(1) No environmental and mandatory reasons to use MDO more expensive
(2) Ice class equivalent to DNV 1A; Confirmation of ice breaker assistance in place; Documentation/confirmation that all necessary permissions from relevant authorities are given; If possible, confirmation of agreement with local salvor (e.g. Atomflot in Russia) and their responsibility in case of towing/salvage; Cover would also be subject to compliance with requirements, recommendations and regulations of local authorities in respect of navigating in ice.
(3) Fibre optic Gyro compass (FOG); HF/MF A4 area; Electronic GNSS compass; Aero VHF; all installed equipment
(4) Personal and group survival kits
(5) IMO Mandatory Basic training course for ice navigation for deck officers
(6) 7 successive NSR areas from Bering Strait to Kara Strait
(7) MDO use for environmental preservation instead HFO
All these figures represent an average and must be adapted to the ice conditions encountered, which vary according to the months of the summer period. Indeed, the road can be extended to bypass areas of high ice concentration but above all the speed can be very slow in these conditions. It can therefore be seen that the gain achieved by the NSR is relatively small and will depend mainly on the fuel used. (fig. 9).

The expenses associated with NSR’s use of the MDO are barely offset by the savings made with less transit time. If the ship uses the same desulphurised fuel (MDO) using the conventional route (see forthcoming regulations, paragraph below), the route through the NSR would become inherently more attractive. However, and this is the main reason, the way a container ship operates between Asia and Europe cannot be limited to comparing two ships with the same capacity, whose only savings would be based on the duration of transit and therefore consumption. This reflection is valid for ships of equivalent capacity such as the transport of gas by LNG Yamal-Max tankers. Since the 2008 crisis, the profitability of container transport has been based on the enormous carrying capacity in a single trip (2600 TEU for a Panamax, almost ten times more for the latest ULCS\textsuperscript{15}, 23,000 TEUs), on intermediate service calls, deep-draught ports (minimum 16 meters), optimized logistics in ports, etc. Moreover, international container companies do not comment on

\textsuperscript{15} ULCS: Ultra Large Container Ship.
the study of these routes. If regional container traffic is to develop, it will only involve travel between two regional destinations to transport highly targeted resources. This is what Maersk has stated that it wants to study with Atomflot for container traffic between St. Petersburg and Vladivostok.

Thus, the gains announced (30%) by the Northern Sea Route rather than the Suez Canal Route are not as interesting as one might suggest. This is one of the reasons why travel companies have little or no interest in organizing a possible summer sea route through the Arctic. Only travel to destinations could be legitimate and global bulk flows are more in line with South/North destinations that do not cross the Arctic, limiting short- and medium-term activity to local traffic serving Russian coastal ports (which have existed for a long time) and rotations between gas and oil terminals - notably Yamal - and their unloading sites.

4. Is the NSR really under exclusive Russian regulation??

The 1982 United Nations Convention on the Law of the Sea, known as the Montego Bay Convention, including all the Arctic 5 countries, with the notable exception of the United States, are signatories, perfectly defining the distribution of maritime spaces. The internal and territorial waters are under the sovereignty of the coastal State; EEZs, exclusive economic zones (and the underlying continental shelf) extending 200 miles from the straight baseline only grant sovereign rights over subsoil resources and the water column. Navigation, known as deep-sea navigation, is free in this area. Looking closely at the 3000 miles route along the Russian coast, a ship can very well sail the high seas without having to enter Russia’s sovereign waters, provided that the two straits used to optimise the route are considered a strait of international status. This is the most commonly accepted view. However, Russia does not have this same perception and relies on an interpretation of international regulations which, although questionable, allows it to assert its authority and legitimacy over the NSR. The recent unassisted transit of the French Navy’s support and assistance ship Rhône along the NSR in September 2018 was the pretext for a vehement reaction from the Russian government. Henceforth, an amendment to the Transport Act requires that all military vessels must apply for permission to transit NSR territorial waters (passage through straits) with 45 days’ notice, give the rank and name of the ship’s master, the nationality of the flag, the duration and reason for transit, submit to the mandatory presence of a pilot and assistance if necessary of an icebreaker and that finally these vessels must have an ice hull adapted to the ice conditions encountered (Kozachenko, 2019). This injunction, in this case, is completely contrary to international regulations since state-owned vessels and therefore warships are not subject to UNCLOS. However, this dispute concerns only the straits to be used by vessels following the NSR. The Russians consider them as internal waters, and therefore sovereign since the 1960s, a claim that was formalized by a Soviet decree in 1985. Americans (and many other states) see them as international straits, and therefore as a safe passage to cross (Solski, 2019). This dispute has never been brought before the competent UN tribunal because of the more than modest stakes for international maritime transport. However, it would be justified if historical customary law on this route were to be recognized in Russia’s favour in view of the very old maritime use of the NSR, a sentiment shared by Canada.

The United States, which is not a signatory to the Montego Bay Convention, constantly reaffirms its commitment to free movement in all the seas of the world. Whether in the China Sea, in the disputed Paracel or Spratleys archipelagos, U.S. Navy ships repeatedly conduct incursion operations in the sovereign waters of these islands illegally claimed by China, FONOPS. Or by announcing last April, in a pre-Arctic Council address by Secretary of State Mike Pompeo, that the United States did not recognize the legitimacy of the Northwest Passage as Canadian inland waters, which provoked a very strong and irritated reaction from the Canadian Prime Minister.

In fact, this imbroglio could find legitimacy in the application of Article 234 of the United Nations Convention on the Law of the Sea, which is applicable only to commercial vessels. For environmental

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16 The first study was carried out in 2007. Out of 85 shipowners surveyed, most container transport companies had replied that they were not interested in the NSR (F. Lasserre - Passages et mers arctiques : géopolitiques d’une région en mutation ; Edition Presse de l’Université du Québec 2010).
17 UNCLOS signed in 1982 in Montego Bay, Jamaica.
18 The 5 states bordering the Arctic Ocean, the Arctic 8 being the 8 permanent states of the Arctic Council.
19 Russia considers all straits along its coasts to be part of its internal waters.
20 State vessels do not have to submit to an authorization from the coastal State for transit beyond its territorial waters, even for the NSR; in this case, the Rhône had informed the Russian authorities and the NSRA of its voyage to Bering.
21 In practice, military navies in peacetime adopt the behaviour imposed on commercial ships.
protection reasons related to the risks of pollution from a ship, this article grants the legitimacy of a coastal State to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from ships in ice-covered waters of the EEZ. The Russian interpretation of this is reflected in the mandatory presence of an ice pilot on board and the escort of an icebreaker depending on the ice concentration and ice class of the ship. Therefore, the NSR Administration, the NSRA, which has been under the authority of Rosatom since February 2019, the same company that manages the Russian nuclear icebreaker fleet, has divided the road into seven zones (fig. 10). Each of these zones has a rate that varies according to the season, the ice class of the ship in transit and the distance from the escort of an icebreaker. The areas of Eastern Siberia (zones 6 and 7) are the most expensive because they are covered with ice for a longer period. Four nuclear icebreakers are generally assigned to escort ships during the summer months. The two most powerful, the *Yamal* and the *50th Anniversary of Victory* are positioned in the Kara Sea and the other two, the *Taymyr Sisterships* and the *Vaygach* in Eastern Siberia.

![Figure 10: NSR fees areas (base chart www.NSRA.ru - ©Hervé Baudu)](image)

So, if the authority of the NSR is not called into question by a shipowner (more precisely its insurers), it will be much more so by flag States that want the free movement of their State and military fleets through international straits. However, this "appropriation" of the NSR throughout the EEZ by Russia imposes obligations on it which must be accompanied by the establishment of means of control and nautical and aerial interventions to ensure safety in these areas. This leads us to ask the question of the security of the NSR.

5. Are NSR’s infrastructures currently enough to ensure safe traffic??

The Hamburg Convention, known as the IMO Convention of 1979, to which all Arctic 5 States are signatories, require these acceding countries to structure the means necessary to ensure the security of the SAR area for which they are responsible. Another convention, signed in 2011 as part of the Arctic Council, a non-governmental forum, divided SAR zones among countries bordering the Arctic Ocean. (fig. 11).

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23 Law adopted by the Duma in December 2018 giving Atomflot, the state institution managing Russian icebreakers, authority over the organisation and management of the Arctic Sea Route.
24 International Maritime Organization, a UN government agency that regulates maritime transport.
25 SAR: Search And Rescue zone, a maritime area under the responsibility of the coastal State to coordinate the means of safeguarding and searching vessels and persons.
Securing the 3000 miles of the NSR is a colossal and extremely expensive project. In the nautical field, the aim is to produce updated nautical charts that comply with IHO standards, which requires hydrographic coverage of the multibeam sonar bottoms along the Northeast Passage; accurate positioning of vessels using a differential beacon coverage GPS or Glonass; to set up virtual AtoN-type beaconing to replace physical beaconing that would not resist the drift of the ice pack; to have AIS receivers on the shore to monitor maritime traffic; to provide local offshore pilotage services in the imposed areas without having to make major detours to major ports to board or disembark the pilot, etc. In terms of saving human lives and assisting ships in distress or difficulty, the means are almost non-existent! Regional Emergency Coordination Centres (MRCC) are few and still very under-equipped and geographically very far apart. Russia had committed to implement 11 on the NSR by 2021. There would only be two operational ones, one in Murmansk and one at the other end of the NSR, in Pevek. Officially, only two MRCCs in the Arctic are listed in the IMO, one in Murmansk and the other in Arkhangelsk. The resources invested are more broadly dedicated to reactivating former military bases or building new ones, in order to assert unequivocally the

26 Standard of the International Hydrographic Organization to produce so-called geo-referenced electronic charts in WGS 84.
27 In order to increase the positioning accuracy of a mobile phone by a satellite positioning system such as the American GPS, Russian Glonass or European Galileo, positioning corrections are emitted in medium wave from coastal ground stations.
28 Aid to Navigation; it is a matter of emitting a remote signal representing a regulatory beacon from a coast station to materialize a hazard without necessarily having a physical beacon at the indicated location. The symbol of the fictitious beacon is read by the AIS receiver on the ship’s Radar or Ecdis.
29 AIS: Automatic Information System; all commercial vessels over 500 UMS must have this receiver, which automatically transmits carrier positioning information with voyage related data. With a range of 30 miles, data are exchanged between ships and land-based traffic monitoring organizations.
30 MRCC; Maritime Rescue and Coordination Center.
exclusive control over this road. If a ship is in distress, nautical and aeronautical response capabilities are also required. Except for two dedicated icebreakers stationed in Murmansk but mainly dedicated to securing Varandey’s oil fields in the White Sea, there are no truly dedicated resources. Claiming control of the NSR route in the 200-mile zone under Article 234 of the United Nations Convention on the Law of the Sea implies that the coastal State must deploy substantial resources to ensure its safety. This is a far cry from what we are talking about. Not to mention the absence of means to combat accidental pollution, the lack of means necessary to ensure these responsibilities are all arguments that can be used by flag States wishing to use this route without being subject to any control. Insurers are not mistaken; the additional premiums are calculated precisely to take these deficiencies into account. It is by putting forward these arguments that we can question the legitimacy of Russia’s claim to control the NSR. Paradoxically, the NSR is subject to significant militarization, including military and air bases, radar stations, listening stations and the latest mobile missile sites. Russia’s message is unambiguous: the NSR is under its control.

About port and maritime infrastructures to ensure the development of trade, everything remains to be done. Except for Murmansk, ice-free all year round and the only international standard port with dedicated shipyards and maritime services, all the others along the NSR are shallow draft river ports that are not able to handle traffic other than local service traffic. 10.3 billion dollars are to be spent on the development of the North Sea Route under Vladimir Putin’s May 2019 decrees, Aleksey Likhachev, Rosatom’s CEO, announced in an interview with Reuters last July. The state’s share would amount to 274 billion rubles (3.8 billion dollars). The rest will have to be covered by private companies such as Rosneft, Novatek, Gazprom, Gazprom Next and Nornickel, all giants in the oil and mineral sector (Staalesen, 2019a). The Russians are convinced of the interest of the development of the NSR, initially essential to export all their energy resources throughout the year to Europe and Asia, and secondly to capture traffic in time in the summer period when, at the end of the decade, icebreakers and maritime safety organisations will be efficient in encouraging shipowners to use this route. Russia derives about 15% of its GDP from the Arctic zone and this economy is vital to regain the status of a world-class nation. And international investors would be seduced by this prospect.

To this end, DP World, one of the world’s largest port operators, a company controlled by the Dubai government that operates 78 maritime terminals, has signed an agreement with a Russian investment fund, the Russian maritime nuclear company Rosatom and Nornickel. The agreement is not legally binding and the parties will first explore options to improve the route and possibly create a joint venture to develop freight transit via the NSR (Golubkova, 2019). Another ambitious project to create hubs for container transport was signed between the Kamchatka Development Corporation (KRKK) and the Primorsky Universal Handling Company (Primorsky CPC) (Humpert, 2019b). Modelled somewhat on the LNG transport from Yamal, the agreement would provide for the construction of a container terminal near Leningrad and Murmansk and another on the Kamchatka peninsula to be completed by 2022 and 2024 respectively. These hubs at the ends of the Northern Sea Route would serve as platforms for loading and unloading containers that would then be transported across the Arctic by icebreaker container ships. One can be sceptical about the economic model of this road as much as the shifting constraints among other things, would be numerous and costly, to which would have to be added transit days to reach these hubs, which are not on traditional commercial stopover routes, not to mention the construction of a dedicated fleet. Because to use the NSR all year round, the ship’s ice category must be very high, like the LNG Yamal-Max ARC7 tankers.

6. Do ships using the NSR have to be of reinforced hull?

Can Russia, for example, require a ship that wants to transit along its coasts to be of a minimum Ice Class? The Polar Code in force since 1 January 2017 does not require a ship wishing to transit through ice-covered areas to have a reinforced hull. However, the Code provides the elements to determine the ship’s ability, with or without its ice class, to navigate in the presence of ice. The NSR regulations define ice conditions and the time of year during which a ship is allowed to transit along the NSR. It also defines the obligation of an escort or not. For a vessel without an Ice Class, it will only be allowed to sail in summer with the assistance

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32 Shifting is the operation at the quayside of unloading and loading containers that determines the duration of the stopover and therefore its cost. It includes in particular the unloading of containers that free up access for those to be unloaded. They will be re-embarlked at the end of the movements. This operation is long and costly.
of an icebreaker escort if the concentration of first year ice is significant. If the NSR is ice-free, a ship without a reinforced hull can easily transit alone.

7. Is NSR expected to compete with roads through the Suez or Panama Canal?

As we have demonstrated above, transit for time travel by the Northern Sea Route, whether for container ships or bulk, does not have enough potential for development. On the other hand, transit from Russian ports to Europe and Asia along the NSR is expected to increase, initially in the summer period and then throughout the year. And it is a strong desire of Russia to develop it quickly. For example, the ARC7 icebreaker tanker Yamal-Max for transporting liquefied natural gas Vladimir Rusanov 33 (fig. 12) loaded with 173,000 m3 of gas from the Sabetta plant made a voyage in July without the assistance of an icebreaker to Okpo in South Korea. He left on June 29, and despite extremely difficult ice conditions in the Eastern Siberian Sea with compressed ice thicknesses of up to two metres, it took him only 19 days of transit to make the transit from Yamal to Asia. It would have taken 35 if the vessel had passed through the Suez Canal, with transhipment in Northern Europe to a conventional LNG carrier (Staalesen, 2019b).

![Figure 12: ARC7 LNG Tanker Yamal-Max Vladimir Rusanov (© Marinetraffic.com)](image)

With the details of the route (Fig. 13), it can be seen that the route is directly imposed by the concentration of ice pack and that the ship did not follow the theoretical route as recommended (Figures 5 and 10). The yellow areas (8/10ths of ice concentration) that reveal ice-free water leads ensure regular transit at a speed of 10 knots. The Laptev Sea was ice-free (0/10th). The East Siberian Sea had a total coverage (10/10th) with very thick compressed ice, which usually requires the assistance of an icebreaker. The rates of progression are then very low. This example shows that it is extremely uncertain to define a transit in time between two ports because ice conditions are so variable. Admittedly, the withdrawal of the extent of the sea ice to its maximum at the beginning of September makes it possible to carry out transit with little sea ice, but this summer period is still extremely limited for traffic with conventional vessels.

33 Her sistership the Eduard Toll has already set a crossing record on this same road in the summer of 2018. There are 15 such vessels called "Yamal-Max" dedicated to the transport of LNG between Europe in winter and Asia in summer.
18 million tonnes of goods were transported on the NSR in 2018\(^{34}\) an increase of nearly 70% compared to 2017. This increase is mainly due to the production of the Sabetta liquefied gas plant, whose three trains went into full production in December 2018. Vladimir Putin’s ambitions are to increase this volume on the NSR to 80 million tonnes per year by 2024. Adding to this the future production of the Arctic LNG 2 project in the Gydan peninsula (19.3 million tonnes of LNG in 2023), the production of coal and nickel ores from the Taimyr peninsula, these volumes are certainly very optimistic but not unrealistic (fig. 14). However, we are very far from reaching the volumes transported by the Panama Canal or the Suez Canal. The number of vessels transiting the entire NSR annually represents the traffic in a single day through the Suez Canal\(^{35}\).

\(^{34}\) This volume does not consider local traffic between Russian ports.

\(^{35}\) Traffic volume per year in the main commercial maritime straits: 70,000 vessels for the Strait of Malacca, 60,000 for the Pas de Calais, 18500 (999 million tonnes) for the Suez Canal and 13,000 (430 million tonnes) for the Panama Canal. The 18 million tonnes are mainly related to destination traffic. Transit traffic through the NSR is only about 490,000 tonnes in 2018.
And yet, it must be admitted that Russia’s vision on the development of NSR through destination traffic is not unrealistic given the enormous potential of hydrocarbon resources lying underground in Russia. All projects aim to develop traffic from Russian ports to Asian and European ports for which there is a high demand. Once port and logistics structures are in place, they could benefit traffic in time for container transport. The recent announcement of Maersk’s plan to operate along this road to provide a transport service in cooperation with the Russian Atomflot serves Vladimir Putin’s ambitions to develop an alternative road to conventional roads (Humpert, 2019c). It is the private operator Novatek, close to the Russian President, which will represent between 5 and 8% of global LNG production thanks to its two mega projects in the Yamal Peninsula (Yamal LNG fully operational in December 2018 and Arctic LNG 2 in service in 2023) which are stimulating the development of NSR. But this development must primarily benefit Russian interests. To this end, successive laws have been passed in the State Duma to ensure a Russian monopoly on the maritime transport of hydrocarbons from its fields, which has even forced the construction of the next LNG Yamal-Max tankers in Russian shipyards.36. Sovcomflot and the Zvezda shipyard in the Kamchatka peninsula (North Pacific coast) have signed a contract for the construction of 17 other tankers for the Arctic LNG 2 project37 (Staalesen, 2019c). Sovcomflot and Novatek have also signed a 25-year charter contract for these vessels (Vedeneeva, 2019). During the winter of 2018-19, freight delivery obligations, the number of LNG Yamal-Max tankers available and the operating costs of these vessels led Novatek to arrange the trips. ARC7 tankers went on a Ship to Ship operation to lighten their load by unloading their cargo with traditional gas tankers anchored in the Norwegian Honningsvåg fjord. 130 transfer operations of several million tonnes of LNG were carried out with more than 300 conventional tankers (Staalesen, 2019d) (fig. 15).

36 An exemption by amendment of the decree was nevertheless made for the fleet of 15 ARC7 vessels already built, only one of which belongs to the Russian shipping company Sovcomflot, the others belonging to the shipping companies Teekey, MOL and Dynagas. 
37 The first 15 tankers were built by the South Korean shipyard Daewoo Shipbuilding & Marine Engineering. The next 17 will be built in cooperation with Daewoo with technology transfer. However, unit costs would be $50 million or 15% higher if they had been built in South Korea. The price difference, up to 20%, will be covered by subsidies from the Russian State budget.
However, in the medium term, Novatek's activities will depend on the establishment of permanent transhipment centres near Murmansk in the west and Kamchatka in the east. Before the end of the year, operations are expected to start near Kildin Island, near Kola Bay with the same organization as in Honnigsvåg. Novatek intends to build a permanent dockside terminal in this peninsula. It will probably be in the Ural Guba, the militarized bay located about 50 km west of Murmansk city and will have a capacity of 20 million tons per year. It would be operated by the French company Total, which already owns Novatek's plants in the Yamal Peninsula. The Chinese, through the Cosco Shipping and Silk Road funds, Sovcomflot and Novatek have also signed an agreement to create a joint venture to manage the organization of transit freight traffic on the Northern Sea Route between Asia and Western Europe (Hand, 2019). The year-round supply of LNG to Asia will continue to be difficult, as the Northern Sea Route used by LNG ARC7 tankers is currently impassable in winter without the support of a nuclear icebreaker. By 2025, if the construction of the 3 Leader nuclear icebreakers is completed (which is highly unlikely) navigation will be ensured on the eastern part of the Northern Sea Route (fig. 16). In the meantime, Novatek may only operate eastward in summer, in which case the current 15 ships will be enough to unload at the hub in the Kola peninsula for the rest of the year. The 3 Leader icebreakers, or even the 5, the 32 LNG ARC7 tankers (15 from the Yamal LNG project and 17 others ordered by Sovcomflot from the Zvezda shipyard) will allow Novatek to transit east all year round to ensure the planned transshipment volume at the Kamchatka hub at 21.7 million tonnes per year. The round-trip duration would be 25 days from Sabetta. In the western direction, Novatek would use only 4 ARC4 lower ice class tankers with an icebreaker escort, enough for a 12-day round-trip transit between Yamal and Kola Bay.
Other specific arguments can be put forward to justify the development of an alternative route for maritime traffic through polar routes. With a global increase in maritime traffic of around 3%, the corridors of international straits and canals could easily be saturated. They are becoming less secure with the possible intensification of piracy in the Horn of Africa or in the Malacca area, they could even be blocked by acts of war. The Arctic area is free of piracy zones and remains a safe road that the Russians, with the high militarization of this area, control. Another example is that due to global warming, the Panama Canal Port Authority recurrently limits the maximum draught in its new locks. The drop-in water level in the intermediate lakes of Gatún and Madden requires a reduced draught to be able to cross them, more restrictive than the capacities of the locks themselves. The draught imposed then becomes almost the same as that of the Sannikov Strait, the most restrictive of the NSR in its coastal version.

Conversely, another regulatory argument could be a constraint on the use of polar roads. In 2020, IMO regulations limiting the maximum sulphur content of marine fuel to 0.5% will come into force. Most cargo ships use heavy fuel oil as fuel (HFO). To comply with the regulations, vessels will have no choice but to use either low sulphur fuel oil (LSFO) or low sulphur diesel fuel (MGO-LS39), or liquefied gas (LNG). Or to equip themselves with smoke purifier and flue gas cleaning devices to continue to use heavy fuel oil (Scrubber). These types of fuel are more expensive and require dedicated refuelling points, which are currently not sufficiently numerous. Rosatom is even considering the possibility of building nuclear-powered container ships to work on the Northern Sea Route, announced at the 12th All-Russia Forum on the Current State and Prospects for Development of the Russian Bunker Services Market by Stanislav Chui, advisor to the Rosatom Industrial Capital Construction Centre (Tchernov, 2019).

38 They are already available for LNG transport through Panama's locks, where slots must be booked well in advance due to a safety requirement that requires LNG tankers to pass through the locks alone. The cost is then higher.
39 VLSFO: Very Low Sulphur Fuel Oil; MGO-LS: Marine Gasoil Low Sulphur.
8. Conclusion

Russia has made the Arctic zone a national priority. It derives more than 15% of its GDP from the exploitation of its hydrocarbon reserves, with the Arctic zone accounting for more than a fifth of its exports. The development potential is enormous. Russia knows that it will become the first natural gas exporting nation in the medium term, it already represents 15%. It is not so much the development of international transit that Russia is looking for, it is more the guarantee that its exports of raw materials for which it is contractually bound are ensured, no longer over a summer period that is getting longer but now throughout the year. If we note in isolation some initiatives that would suggest that polar roads are really attractive, Russia is developing its alliances only with the sole aim of being able to channel its hydrocarbon and mineral resources, whatever the time of year, to Europe or Asia. Alliances with countries and industrialists are necessary to develop this industry because Russia does not yet have the technologies and financing necessary for its ambitions. There is no doubt that it will eventually succeed, not necessarily within the expected time frame, but the development of this seaway is assured in the medium term. Certainly, opportunity traffic will develop, particularly for bulk destination traffic and, to a lesser extent, containerized traffic in time. The entire development of Arctic maritime transport, which will remain very modest over the next two decades, is taking place in a geopolitical context that is still stable for traditional international maritime routes and in a low-voltage environment in the Arctic region. What if the corridors of major maritime transits were to become congested, such as the Strait of Malacca, the Suez Canal and the Panama Canal, or even risky, such as in the Strait of Hormuz at the entrance to the Persian Gulf where tankers are arrested or targeted??

Maritime transport, an industry of opportunity, could then very quickly adapt and invest in Arctic roads.

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