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Editorial

Special Issue: Design, management, sustainability and evaluation of transportation systems in the Arctic

Natural resources, such as oil and gas and rare earths, which have been out of mankind's reach in the Arctic for centuries, have recently become a new economic opportunity. In parallel, the ice melt, a direct consequence of global warming, has opened navigation along the coastal states for a longer period per year.

Nevertheless, the development of the Arctic navigation is framed by different policies imposed and implemented by various stakeholders present in this region. Aware of the strong relationship between the related policies and the development of maritime transportation, this Special issue aims to stress the influence that port, risk, and sustainability policies can have on the attractiveness of Arctic shipping.

This Special Issue consists of nine high-quality articles that shed light on different aspects related to Arctic transportation including the way the Arctic Ocean is analyzed by academics and the related topics (Panahi et al., 2021; Lavissière et al., 2020) and also Arctic marine risk management (Benz et al., 2021; Zhang et al., 2020). In addition, Rigot-Müller et al. (2022) demonstrate the relevancy to use the Northern Sea Route (NSR) for infrastructure projects, with the Yamal project as a case study, while considering risk management. Moreover, as most of the flows shipped along the Russian Arctic shores concern hydrocarbon materials, Theocharis et al (2021) investigate the profitability of such transportation opportunities. Furthermore, the NSR attractiveness is studied from a sustainability point of view by considering the economic and the environmental aspects by Lambert et al (2021) and Dai et al (2021). Finally, Xu and Yin (2021) investigate the optimal icebreaker charges for tramp shipping in the Arctic.

More specifically, the first two contributions in this Special Issue by Panahi et al (2021) and Lavissière et al (2020) investigate the key differences between the eastern and the western parts of the Arctic. Indeed, Arctic countries do not have the same policies for Arctic socio-economic development. The Russian economy is very dependent on raw materials and aims to place the North-East Passage (NEP) as a potential challenger to the Suez Canal Route (SCR) or at least as another available alternative for maritime shipping between the East and the West that adds up to the capacity of the southern shipping lanes, while the policy implemented by Canada is more focused on the supply of northern communities. The consequence of such different approaches lies in the critical difference between the Arctic port networks developed by those two countries (Panahi et al., 2021). Moreover, as stressed by Panahi et al (2021), the way ports are analyzed along the NSR differs from those making up the North-West Passage (NWP). However, port analysis over recent years has appeared to be limited, compared to other Arctic related topics studied in the literature (Panahi et al., 2021). That is why Lavissière et al (2020) review the existing literature dealing with Arctic transportation and confirm that most articles have covered shipping and maritime transport issues rather than port and cruise related topics, for example. From a geographical point of view, another element highlighted by Lavissière et al (2020) is that the majority of the studies has focused on the NSR. Additionally, they identify five major areas for further investigation: the tactical perspective and management approach of issues in the field, risk management, logistics systems to access the Arctic routes, major clustering projects development in the area, and management of specific fleets required by the extreme conditions.

The third article in this Special Issue by Benz et al (2021) consider the numerous hazards that are related to Arctic sailing and analyze the corresponding response capacities that need to be deployed in the Arctic by the coastal states in order to cope with these hazards. As 512 incidents occurred in the Arctic during the last decade, Benz et al (2021) stress the importance of a framework of Search and Rescue (SAR) and the different elements that such a framework should consist of. They propose a comprehensive framework integrating port infrastructures, SAR equipment, communication technologies, navigation technologies, standards, agreements and cooperation.

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In the same vein, the fourth article by Zhang et al (2020) consider the risk of being stuck in the ice and the risks of hull damage that may result from unsuitable vessel sailing speed. The authors assume that a ship with too high a speed could lead to a collision while a low sailing speed could increase the probability of being stuck in the ice. Thus, using a Bayesian network (BN), they assess the optimal speed to provide safe navigation in the Arctic.

In addition to being able to develop new maritime infrastructures in the Arctic area that allow to explore the natural resources, or to supply existing ports, the use of maritime transportation and adequate vessels is a must. Yet to develop safe navigation for these vessels, the choice of the suitable sailing speed is one of the key safety factors. Among the projects that exist in the Russian Arctic, the construction of a liquefied natural gas (LNG) plant is one of the most complex. In this context, the fifth paper written by Rigot-Müller et al. (2022) examines the role of the Polar Code policy framework and related tools on the planning of the highly strategic Yamal project. Their results highlight that the use of Polar Class vessels allowing year-round navigation in Arctic waters is critical to providing appropriate polarseaworthiness and to ensuring the success of such projects in different ice conditions. It also emphasizes the paramount role of the POLARIS tool in the shipping-related risk management of Arctic infrastructure projects.

The sixth contribution by Theocharis et al (2021) confirms that in addition to being a crucial element in operational risk management while navigating in the Arctic, sailing speed is also a paramount element in terms of profit. In this analysis, the authors define the best speed to minimize the required freight rate (RFR) using a speed optimization model. Their analysis uses real speed data between 2011 and 2019 in summer and winter. Moreover, as the heavy fuel oil (HFO) will be banned mid-2029, the authors assumed that vessels are fueled with very low sulfur fuel oil (VLSFO) and LNG.

As the Arctic ecosystem is highly sensitive to the human activities and to their resulting consequences such as greenhouse gas (GHG) emissions, the International Maritime Organization (IMO) has decided to ban the use of HFO by the end of the decade. To stress the impact of such constraints on the economic attractiveness of the NSR, the seventh paper of this Special Issue by Lambert et al (2021) develops a model integrating numerous elements such as the use of alternative fuels. Based on micro economic theory, the results of this study underline that if it is combined with the SCR and in case of use of Emission Control Areas (ECAs), the use of the NSR can be profitable by 2035 and the Transpolar Sea Route (TSR) by 2050 for a Handymax wet bulker with a moderate ice-class.

Given that LNG is one of the main cargos shipped from the Arctic zone, Dai et al (2021), in the eighth paper, study the impacts of shipping LNG from Sabetta along the NSR using an ARC4 vessel and analyze both the environmental and economic perspectives. As their aim is to define the amount of GHG emitted according to the season, they consider different types of fuel such as HFO, LNG and marine diesel oil (MDO). First, their results highlight the fact that the LNG cost evolves depending on the season. Second, they show that if HFO is more competitive in terms of cost, the use of LNG will be more sustainable.

Another techno-economic factor that plays an important role in the NSR profitability is the need for icebreaker assistance. It depends on ice conditions and on the rules and regulations put in place including the corresponding tariff policy. If this impact has been well documented by academics, the approach chosen by the ninth study of this Special Issue (Xu and Yin, 2021) has been less considered in the literature. Xu and Yin (2021) define the optimal icebreaker tariff level from the pricing authority side so that it covers the cost of icebreaker maintenance without negatively impacting the NSR attractiveness. Their analysis reveal that the optimal tariff level would be 15% higher than the current one and that the resulting level of price may still allow the NSR to save between 4.5% and 12.4% compared to that of NSR.

To conclude, the nine papers of this Special Issue investigate the economic, environmental, operational, and policy related aspects of the navigation in the Arctic and in particular along the NSR. They show the potential economic attractiveness of the NSR and the required conditions to make it viable. They also contemplate the environmental impacts NSR shipping may have and what the best options to reduce these impacts are.

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