

The Polar Code's Implications for Safe Ship Operations in the Arctic Region

E. Engtrø, O.T. Gudmestad & O. Njå
University of Stavanger, Stavanger, Norway

ABSTRACT: Simultaneously with a decreasing sea ice cover in the Arctic region an increase in ship traffic is experienced in these waters, meaning a higher probability of accidents and incidents to occur. The capability to handle emergency situations for shipowners, operators and rescuers in a cold climate environment are heavily affected by the risks present in polar waters and depends on limited emergency response resources covering extremely large areas. In 2017, the International Code for Ships Operating in Polar Waters (The Polar Code) was adopted by the International Maritime Organization (IMO), applicable for the Arctic and Antarctic regions. The goals of the functionally based regulation are to provide for safe ship operations and the protection of the polar environment, by addressing risks present in polar waters and to ensure these are mitigated sufficiently. A qualitative pilot study, with individual expert interviews, has been conducted in order to examine the Polar Code's implications for safe ship operations in the Arctic region. The study concludes that the discussions raised in the aftermath of the Polar Code has led to an increase in focus and a strengthened consciousness about hazards and risks associated with polar water ship operations and additional measures required to mitigate these. Further, the implementation of the Polar Code is considered as a milestone by establishing an international regulation, mandatory for polar water ship design and for voyage planning. However, the study points out that the main principle of the Polar Code is risk-based, meaning the performance of safe ship operations are depending on those subjects to the regulation, to conduct thorough operational risk assessments covering all actual hazards, and to ensure that those are mitigated sufficiently. In this regard, authority presence is found crucial, to validate the adequacy and the dimensioning of the implemented measures. Key words: Arctic ship operations; regulatory governance; emergency response; risk management.

1 INTRODUCTION

In 1989, the oil tanker Exxon Valdez ran aground near the coast of Alaska, and one of history's largest environmental disasters at sea was a fact. The accident subsequently raised public awareness and speeded up the process of establishing a mandatory international regulation for ship traffic in polar regions [13]. International laws and the laws of coastal states with territorial sovereignty regulated marine activity in these waters, and these laws could be

contradictory [3]. From the early 1990s, the International Maritime Organization (IMO) started the work to develop a regulation which could meet the extraordinary risks associated with voyages in the Arctic and Antarctic regions, as additional requirements applicable for ship operations in polar waters were lacking. In 2016, the work was finalized, resulting in the International Code for Ships Operating in Polar Waters (The Polar Code) [9], a function-based regulation, applicable from January 1st, 2017. The Polar Code was developed in a

collaboration between member states of IMO, amongst which Norway, represented by the Norwegian Maritime Authority (NMA), had a leading role.

2 THE POLAR CODE CONTENT

The Polar Code is a continuation of existing IMO regulations, made mandatory under 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 regulation contains requirements regarding the design and construction of vessels and equipment, operational conditions and training, and the protection of the environment. The Polar Code consists of two parts; Part I contains provisions on safety measures, made mandatory under SOLAS Convention, defining minimum performance standards for ship systems and equipment; Part II contains provisions on measures to prevent pollution, made mandatory under the MARPOL Convention. The provisions on safety measures (Part I) are of interest in this article, applicable to passenger ships carrying more than twelve passengers or cargo ships with a gross tonnage of 500 or more engaged in international voyages [11].

The geographical area of application in the Arctic is shown in the figure 1. In the Antarctic, the regulation is applicable at 60th parallel south.



Figure 1. Maximum geographical extent of the Polar Code's area of application in the Arctic. The figure extracted from the Polar Code is for illustrative purposes only. For exact coordinates, the regulation refers to SOLAS Chapter XIV/1.3 [11].

Ships which comply with the requirements in the regulation are issued a Polar Ship Certificate on behalf of IMO. The certificate shall specify vessel type, ice class, polar service temperature, maximum expected time of rescue, vessel restrictions and operational limitations for ice conditions, temperature and high latitudes. The Polar Code acknowledges that the risk level may differ depending on the geographical location and time of year, and

mitigating measures required to address hazards may therefore vary within polar waters. Capabilities and limitations identified in the operational assessment performed for a vessel shall be documented in the Polar Water Operation Manual (PWOM), to be carried onboard when on voyage.

3 METHODS FOR INTERPRETING "THE POLAR CODE EFFECT"

The topic in this article is risk regulation of marine activities at an international and governing level, with complex problems of concern, to be handled by a variety of industries and regulated parties. Several uncertainties exist, in particular the capability to handle emergency situations, both for shipowners, operators and rescuers in a cold climate environment, heavily affected by the risks present in polar waters. As the requirements in the Polar Code are based on risk factors in the operating areas, the problem for discussion is the extent to which the regulation attributes for enhanced risk management of polar water shipping operations, considering all the uncertainties associated with voyages in these waters. Areas of interest in this regard are:

- Expectations towards regulatory compliance and the establishment of practical solutions.
- Interpretation of the Polar Code's requirements and developmental trends.
- The Polar Code's contribution in defining best standards for ship operations in polar waters.

Empirical research is conducted to provide data to assess the Polar Code's implications as regulation for ship operations, in this study limited to the Arctic region. The data for this research comes from interviews, academic papers, guidelines and reports. Academic research covering various aspects and challenges associated with Arctic ship operations and emergency preparedness in polar waters is comprehensive [1], [2], [19], [21], [38] and the implications and consequences associated with the implementation of a mandatory regulation for polar water ship operations are of interest. Research covering the topic is, for example, found in the extensive SARex I, II & III exercise reports from 2016, 2017 and 2018, respectively [34], [35], [36]. During these exercises the Polar Code was used as a base for testing life-saving appliances (LSA) and rescue equipment in a cold climate; personal capabilities for survival in real-event situations were studied, and training in emergency scenarios was conducted [34], [35], [36]. The exercises, each lasting one week, were held north of Spitzbergen in ice-infested water or to onshore, with an objective to identify and explore the gaps between the functionality provided by the existing SOLAS approved safety equipment and the functionality required by the Polar Code [34], [35], [36]. The reports from the SARex exercises, with their individual contributions from the participants in the appendices, are valid sources of data, containing detailed descriptions and evaluations of emergency response resources and requirements for polar water operations, both from a technical, operational and organizational point of view.

3.1 Interviews

A pilot study has been conducted in order to gain data about the Polar Code and its implications for safe ship operations in the Arctic region. Individual interview as method was selected, which is the most commonly data collection strategy in qualitative research [31]. The method of interviewing experts enables for in-depth examination to capture the informant's knowledge and understanding of the studied topic [12], [18]. The selection criteria for choosing informants for this study were thorough expertise and knowledge about the Polar Code, gained through work experience in the making of the regulation prior to 2017, after the regulation was implemented, or both. Six informants who met all the defined criteria were selected, represented by the NMA, the Norwegian Coastal Administration (NCA), the classification societies and the academia (ice navigation specialist). The interviews were conducted during January 2020 - four interviews in person and one via telephone. In addition, formal conversations were held with one of the informants during the same period, in person, via telephone and mail correspondence. An interview guide was developed containing questions concerning safe ship operations in northern areas and challenges associated with the enforcement of the Polar Code. The interviews were conducted in a semi-structured manner, allowing flexibility to explore spontaneous issues raised by the interviewees [30], all lasting approximately one hour with use of the interview guide. The following regulatory topics were addressed during the interviews, all considered as a result of the Polar Code implementation, provided as additional guidance and clarifications for regulatory compliance:

- Guidance on methodologies for assessing operational capabilities and limitations in ice; Polar Operational Limit Assessment Risk Indexing System (POLARIS) (2016) [7].
- Amendments to STCW on qualifications and certificates for seafarers (2018) [26].
- Guidance for navigation and communication equipment intended for use on ships operating in polar waters (2019) [8].
- Interim guidelines on life-saving appliances and arrangements for ships operating in polar waters (2019) [10].
- Regulations on the construction, equipment and operation of passenger ships in the territorial waters surrounding Svalbard (2020) [28].

The collected data were analyzed utilizing thematic analysis as a method, which is a widely used qualitative analytic method for identifying, analyzing and reporting patterns and themes in data [4]. Themes were identified using a deductive and theoretical approach, providing a detailed analysis of certain aspect of the collected data [4]. The thematic analysis were conducted with the following steps: (1) familiarizing by transcribing the data, (2) generating initial codes by exploring features of interesting data across the entire data set, (3) collating the data relevant to each code in a systematic manner, (4) collate codes into potential themes and review these themes by checking logical relationship to the coded extracts and the entire data set, (5) defining and naming the themes, (6) final analysis of selected

extracts [4]. However, analyzing data is not a process conducted in a linear manner moving from first phase to second and third. Instead, the process is dynamical, moving back and forth as needed, throughout the phases [4]. The themes identified in the thematic analysis forms basis for the topics discussed in chapter 4.

4 DISCUSSION - REGULATORY GOVERNANCE AND FUNCTION-BASED REGULATIONS

Function-based regulations, as the Polar Code, are increasingly applied in regulatory governance, where the responsibility for developing and establishing operational standards and procedures is delegated from government officials to the subjects and target groups that the regulations are intended to regulate. From a rational approach, functional requirements enable shipbuilders, owners and operators to choose flexible solutions, suitable to own activities and operations. Self-regulation as principle demands strong professional integrity and high levels of competence, from those subject to the regulation but also from the assigned authorities, represented by the flag states, the port states and the recognized classification societies.

During the interviews it became evident that the implementation of the Polar Code initially did not have a great impact for the experienced operators and shipowners, already engaged in polar water operations in the Arctic region. Their fleet generally consisted of winterized vessels, designed for low temperatures and built according to recognized ice classes, and in most cases only minor technical modifications were necessary for reaching compliance with the new regulation. Routines for developing operational procedures for operating in ice were also well-established, and often only cross-references to the individual sections of the Polar Code were sufficient for reaching compliance with the regulation. One informant pointed out that the Polar Code has gained criticism for its functional formulations, but at least a minimum standard and expectation for operational elements and for vessel design and construction is established. Even so, the informant explained, ship builders or ship owners lacking polar experience and knowledge have difficulties to acknowledge this minimum expected standard, which manifests when operational capabilities and limitations in ice are addressed in the early stages of the design phase of a vessel. Another informant pointed out what he called the function-based paradox; the Polar Code addresses a minimum of specified hazards and risks to be treated in an operational risk assessment for the vessel and its intended voyages, however, unexperienced personnel will have great difficulties identifying and assessing all the related ones.

4.1 From function-based regulations to descriptive guidelines

International shipping operations are regulated by IMO Conventions and regulations, established through extensive cooperation and often time-

consuming work, characterized by the time it took to develop and agree on the Polar Code (> 25 years). In these forums scientific facts can be diminished in favor of political and economic interests, as visions and goals are to be agreed on amongst differing cultures, institutions and states with competing agendas and financial situations [32]. In the making of the Polar Code, one informant recalled the discussions within IMO, addressing requirements for LSA, describing them as controversial, resulting in less descriptive requirements for this chapter compared to the other chapters of the Polar Code. However, in parallel with the ongoing work of finalizing the regulation in 2015, the same informant participated in the development of interim guidelines for LSA and arrangements, which was put on the agenda by the NMA, in order to provide additional guidance and clarification to the Polar Code. The strategy of first developing interim guidelines within IMO were debated, but according to the informant consensus were easier achieved by establishing voluntary guidelines compared to mandatory ones. During the next three years, findings from the SAR exercises [34], [35], [36] raised concerns regarding the suitability and efficiency of equipment to be provided in an emergency abandonment situation of vessels, and the exercises proved that vessels in polar voyages likely were equipped with insufficient survival equipment and resources, including food and water rations. The results from the exercises and the discussions that arose after these events contributed in the development of the interim guidelines, which were put to force in 2019 [10].

The interim guidelines for life-saving appliances and arrangements for ships operating in polar waters [10] states that survival after abandonment relies on several factors, such as the types and combination of equipment, crew training and good leadership of each survival craft. Guidance is also provided for the type and amount of survival equipment related to the maximum expected time of rescue. One informant acknowledged the guidelines for its scientifically based content, developed on experience from the SARex exercises, and considered the guidelines to be useful in verification activities of vessels and as a guiding tool for voyage planning. The informant also considered the chronological process within IMO, of first developing interim guidelines before being made mandatory, to be a sustainable way to handle controversial matters, considering that acceptance is easier achieved in the making of voluntary guidelines.

A controversial topic during the development of the Polar Code and in the making of the interim guidelines for LSA and arrangements, according to one informant, was the requirement regards maximum expected time of rescue, set to never be less than five days. The requirement is still debatable and by some considered more as a theoretical statement, questioning the capability for LSA to keep (elderly) people alive for a minimum of five days, after a vessel abandonment [39]. According to the informant, many operators adopt to the requirement without any further assessment, in particular to assess if the expected time of rescue may also exceed five days, which can be the case for ships with a large number of persons on board, operating in the most remote parts of the Svalbard archipelago. A dilemma in the

discussion concerning time of rescue [33], addressed by one informant, is the lack of a shared understanding or a definition concerning when one can be considered rescued, adding another uncertainty to the topic.

4.2 *Function-based requirements - expectations and obligations*

Due to the Polar Code's risk-based principle, sufficient measures will highly be depending on geographical and seasonal variations. The Polar Code requires operational limitations, including limitations related to ship structural ice capabilities, to be established and documented in the Polar Ship Certificate and the PWOM, utilizing an acceptable methodology, namely the POLARIS. The basis of POLARIS is an evaluation of the risks posed to the ship by the expected ice conditions in relation to the ship's assigned ice class [7]. The main challenge by applying a risk-based ship design is related to the definition of the ice environment and the ship-ice interaction in this varying environment [15]. Comparing ice environments is a complex matter as ice can have various forms and can be first, second or multiyear ice, which will have large impact on the strength properties of ice as well as on the possible thickness [16]. In addition, ice fields are dynamic and changes on the ice cover characteristics can happen rapidly e.g. due to the wind and currents [16]. In voyage planning, shipowners or operators responsible for conducting adequate operational assessments, can deliberately mislead or non-deliberately underestimate the risks of encountering first-year ice or older and thicker ice or large ice ridges. Certain calculators can take advantage and exploit the risk-based principle in the regulation, which raises questions about the authority's role in the regulatory regime [29]. One informant pointed out the importance of authority presence in Norwegian ports and waters, enforcing compliance with operational limitations, Polar Class (PC) and the maximum expected time of rescue, as specified in the Polar Ship Certificate for the vessels. The informant suggested an ad-on to be established to existing vessel reporting systems, for submission of operational assessments, to be reviewed and verified by the authorities before approval for polar voyages is given.

According to two informants, there is limited experience in Norway utilizing POLARIS in the establishment of operational limitations, which partly was explained by lack of data in existing ice charts; Norwegian ice charts do not have a standard colour code system separating ice types from each other, used by other Arctic nations as Canada, Russia and Greenland. In POLARIS, a ship is assigned a Risk Index and the Risk Index Values within the Risk Index are values corresponding to a relative risk evaluation for corresponding ice types [7], meaning detailed and accurate information about ice types and ice conditions is essential input to the system. Canada with long traditions for ice navigation uses two systems: The Zone/Date System (ZDS) and the Arctic Ice Regime System (AIRSS); the last-mentioned enforced in 1996 and considered as an equal acceptable alternative methodology to the later developed POLARIS. The ZDS, however, is a fixed

system based on historical data on ice conditions, dividing the Canadian Arctic waters into control zones and stipulates the opening and closing dates for each zone for different vessel types [14]. The system encounters that ice conditions are consistent from year-to-year and does not reflect long term trends and inter-annual variability in ice conditions, leading to the development and introduction of the more flexible AIRSS [14].

The ongoing EU earth observation program, "Extreme Earth", involving the Norwegian Meteorological Institute / Norwegian Ice Service, working with large scale analysis of remote sensing data which can support information in the development of more advanced ice charts, was mentioned by the two informants. In these discussions it was pointed out the importance of obtaining high quality data about ice conditions when utilizing a risk-based ship design system.

4.3 *The establishment of international maritime norms*

In 2018, amendments to the STCW on qualifications and certificates for seafarers [26] were laid down on the background of the Polar Code implementation. The amendments primarily involve training requirements for masters, chief mates and officers in charge of a navigational watch on ships with a Polar Ship Certificate operating in open and other polar waters. During the training courses topics concerning legislations, ice classes, ice types and ice conditions, meteorological and oceanographic conditions, and LSA are addressed. The training must be documented with a certificate of proficiency from an educational institution offering Polar Code training courses (basic and advanced). Two of the informants were lecturers in the above-mentioned courses and recommended the training to be applicable for additional personnel with non-navigational duties, e.g. engine department, where cold climatic conditions also will affect equipment and human performance. Both informants expressed their concern for the competence level for personnel on vessels operating in ice-free polar waters or in waters outside the application area to the Polar Code; icing, low temperature, extended periods of darkness or daylight, rapidly changing and severe weather conditions and lack of suitable emergency response equipment are hazards and concerns also applicable in waters not regulated by the Polar Code.

A general concern was addressed towards non-SOLAS vessels operating in cold climate areas, including cargo ships of less than 500 gross tonnage; pleasure yachts not engaged in trade; and fishing vessels [11]. The safety provisions (Part I) of the Polar Code is mandatory for certain ships under the SOLAS Convention and non-SOLAS vessels are therefore not regulated by the Polar Code. However, IMO's Maritime Safety Committee and related sub-committees are currently looking at the application of the Polar Code to vessels not regulated by SOLAS Convention. The IMO assembly meeting in end of 2019 adopted a resolution on interim safety measures for vessels not certified under the SOLAS Convention operating in polar waters, which urges the IMO member states to implement, voluntarily, the safety

provisions (Part I) of the Polar Code on non-SOLAS vessels.

January 1st, 2020, the NMA laid down new Regulations on the construction, equipment and operation of passenger ships in the territorial waters surrounding Svalbard [28], making the Polar Code, with a few exceptions and additions, applicable as regulations in these waters [28]. Until that date, ships with national certificates have not been subjects to the safety provisions (Part I) of the Polar Code but to MARPOL and national requirements for certificates required to operate passenger ships at Svalbard [27]. The Polar Code's safety provision applies, per definition, only to passenger ships or cargo ships engaged in international voyages [11]), where an "international voyage means a voyage from a country to which the present Convention applies to a port outside such country, or conversely" [11]. For this reason, passenger ships or cargo ships in voyages in the territorial waters surrounding Svalbard, going from and returning to a port in Norway, have not been subjects to the Polar Code's safety provisions. According to one informant, interpreting the Polar

Code in this manner was not supported by the NMA representatives in IMO during the making of the regulation, and the NMA recommended all SOLAS vessels operating within the Polar Code application areas should comply with the regulation.

According to one informant, varying interpretation of the Polar Code and enforcement of the regulation amongst flag states can be mitigated when the new Regulations on the construction, equipment and operation of passenger ships in the territorial waters surrounding Svalbard [28], is put in to force, as future development of the legislation in Svalbard will take place in line with new legislation being negotiated internationally in IMO. Due to Svalbard's judicial position [37], the necessity for equal rules for all flag states, will cause predictability and clear legislation, which is an advantage point for the NMA also regulating ships flying foreign flags [28].

5 CONCLUSION AND SUMMARY

The shipbuilding industry delivering polar expedition vessels for the Arctic region is peaking, with 28 new builds expected launched in a four-year period going from 2018 to 2022. This is additional to the almost 80 polar vessels already in voyage in these waters [39]. The increase seen in activities related to science, tourism, shipping, fisheries and commercial aviation in polar regions, means a higher probability of accidents, incidents or requirement for emergency response, depending on limited resources covering extremely large areas [6]. New polar expedition vessels are in general delivered with higher ice-classes (PC) than existing ones, enabling voyages in even more remote areas outside the regular sailing season during summertime [39], going from May to September in the Arctic region. This concern was shared by one informant, who by use of the Automatic Identification System (AIS) for vessels, had observed the same trend; more vessels in voyages in remote and less explored areas. The informant elaborated about his concern for the increased risk for

grounding, with better equipped and larger vessels with deeper drafts, exploring new areas with limited hydrographic data, and expressed his concerns related to the human element of risk, highly influenced by personnel skills, competency and knowledge.

The use of POLARIS and equal analytical models quantifying risk levels are depending on reliable input, however, a significant uncertainty is represented by the analysts' risk perception of descriptive scenarios [5]. These concerns were discussed several times during the interviews; the importance of gaining access to accurate data about weather and ice conditions, acquired on a daily basis, and that the capacity to fully understand the characteristics and severity of risks and hazards associated with ship operations in polar regions comes with experience. Operational assessments performed to identify capabilities and limitations for vessels must be re-assessed frequently before found reliable. Research from comparable industries has shown that thorough re-verifications of conducted risk assessments very rarely occur [23], [24], [25], which is a concern that needs to be addressed. The management of control mechanisms and constraints enforcing the Polar Code is of essence and key players in this control regime are port states, flag states and classification societies, followed by the Arctic Council and other nations with interests in the Arctic region. The use of sanctions – fines and withdrawal of the Polar Ship Certificate – are possible reactions, as well as, in extreme situations, the arrest of vessels. Authority involvement, by addressing responsibilities within the industry in a competent manner, is crucial to reduce and eliminate favourable conditions for disreputable parties. Previous experiences from maritime disasters indicate a business sector with some members posing a challenging reputation.

Regulating ship operations, both during design of vessels and for voyage planning, utilizing function-based requirements should be further evaluated, considering the uncertainties represented by geography, environmental conditions and challenges associated with search and rescue (SAR) operations in remote areas with limited resources. Parallels can be drawn with the heavy vehicle transport industry, where research indicates that functional requirements are being stretched [17], [22]. A systemic theoretical approach [20] in the assessment of regulatory constraints, and their functionalities for polar water ship operations could be enlightening, considering the use of function-based provisions supplemented with descriptive guidelines. However, the use of descriptive requirements can turn out to be counter-effective, if compliance is achieved in a mechanical manner, with just checks and controls of predefined measures without conducting re-assessments of the operational conditions.

During the interviews and in the conversations concerning the Polar Code's implications for safe ship operations in the Arctic region, the interviewed in unison acknowledged the implementation of the Polar Code as an important milestone achieved; an international and mandatory regulation, defining minimum expected requirements for polar water ship design and for voyage planning have been established. One informant pointed out that the

“reactive” parts of the Polar Code, e.g. the chapter covering LSA and arrangements, have gained more attention than the “proactive” parts of the regulation, e.g. the chapters concerning ship structure, safety of navigation and voyage planning. In the discussions regards minimum expected standards and the way forward, the establishment of buddy-systems, with two vessels operating together in the same area, was mentioned as a mitigating measure that should gain more focus in the operational assessments and during voyage planning.

REFERENCES

- [1] Andreassen, N., Borch, O. J., Kuznetsova, S., & Markov, S. (2018). Emergency Management in Maritime Mass Rescue Operations: The Case of the High Arctic. Sustainable Shipping in a Changing Arctic, WMU Studies in Maritime Affairs 7. doi:https://doi.org/10.1007/978-3-319-78425-0_20
- [2] Antonsen, Y., Skjetne, J. H., Haugstveit, I. M., Walderhaug, S., Anfinsen, S., Ellingsen, M.-B., & Håheim-Saers, N. (2016). SARINOR WP 6 Delt situasjonsforståelse under søk og redning i nordområdene. doi:<https://doi.org/10.13140/RG.2.2.20276.09604>
- [3] Bai, J. (2015). The IMO Polar Code: The emerging rules of Arctic shipping governance. The International Journal of Marine and Coastal Law, 30(4), 674-699. <https://doi.org/10.1163/15718085-12341376>
- [4] Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101. doi:10.1191/1478088706qp063oa
- [5] Braut, G. S., Rake, E. L., Aanestad, R., & Njå, O. (2012). Risk images as basis for two categories of decisions. Risk Management: An International Journal, 14, 60-76.
- [6] Council of Managers of National Antarctic Programs (COMNAP). (2019). Antarctic Search and Rescue (SAR) Workshop IV - Improving SAR Coordination and Response in the Antarctic. Retrieved from: <https://www.comnap.aq/Publications/Comnap%20Publications>
- [7] International Maritime Organization. (2016). Guidance on methodologies for assessing operational capabilities and limitations in ice; Polar Operational Limit Assessment Risk Indexing System (POLARIS). MSC.1/Circ. 1519. London: International Maritime Organization.
- [8] International Maritime Organization. (2019). Guidance for navigation and communication equipment intended for use on ships operating in polar waters. MSC.1/Circ.1612. London: International Maritime Organization.
- [9] International Maritime Organization. (2017). International Code for Ships Operating in Polar Waters (The Polar Code). MEPC 68/21/Add.1 Annex 10. London: International Maritime Organization.
- [10] International Maritime Organization. (2019). The interim guidelines for life-saving appliances and arrangements for ships operating in polar waters. MSC.1/Circ.1614. London: International Maritime Organization.
- [11] International Maritime Organization. (2001). SOLAS: International Convention for the Safety of Life at Sea, 1974, and 1988 Protocol relating thereto: 2000 amendments, effective January and July 2002. London: International Maritime Organization.
- [12] Jacobsen, D. I. (2015). Hvordan gjennomføre undersøkelser? : Innføring i samfunnsvitenskapelig metode (3. utg. ed.). Oslo: Cappelen Damm akademisk.

- [13] Jensen, Ø. (2016). The International de for Ships Operating in Polar Waters: Finalization, adoption and Law of the Sea implications. *Arctic Review on Law and Politics*, 7(1), 1-23. <https://doi.org/10.17585/arctic.v7.236>
- [14] Kubat, I., Collins, A., Gorman, B., & Timco, G. (2005). A Methodology to Evaluate Canada's Arctic Shipping Regulations. Paper presented at the International Conference on Port and Ocean Engineering under Arctic Conditions (POAC).
- [15] Kujala, P., Goerlandt, F., Way, B., Smith, D., Yang, M., Khan, F., & Veitch, B. (2019). Review of risk-based design for ice-class ships. *Marine Structures*, 63, 181-195. doi:10.1016/j.marstruc.2018.09.008
- [16] Kujala, P., Kämäräinen, J., & Suominen, M. (2019). Validation of the New Risk Based Design Approaches (POLARIS) for Arctic and Antarctic Operations. Paper presented at the International Conference on Port and Ocean Engineering under Arctic Conditions (POAC).
- [17] Kuran, C. H. A., & Njå, O. (2016). Rule bending in the road based commercial goods transport sector - A systems theory approach. Paper presented at the The 3rd International Conference on Transport and Traffic Engineering, ICTTE, Belgrade, Serbia.
- [18] Labuschagne, A. (2003). Qualitative research--airy fairy or fundamental?(Report). *The Qualitative Report*, 8(1), 100.
- [19] Latola, K., & Savela, H. (2017). *The Interconnected Arctic – UArctic Congress 2016 (1st ed. 2017. ed.)*.
- [20] Leveson, N. (2011). *Engineering a safer world: Systems thinking applied to safety*. Cambridge, Mass.: The MIT Press.
- [21] Marchenko, N., Andreassen, N., Borch, O. J., Kuznetsova, S., Ingimundarson, V., & Jakobsen, U. (2018). Arctic Shipping and Risks: Emergency Categories and Response Capacities. *TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation*, 12(1), 107-114. doi:10.12716/1001.12.01.12
- [22] Njå, O., Braut, G. S., & Vika, O. E. (2012). Bending the rules in the commercial goods road transport sector. *Procedia - Social and Behavioral Sciences*, 48, 2336-2350.
- [23] Njå, O., & Solberg, Ø. (2010). Safety considerations in political decisions: A case study of changes to the Norwegian aviation system. *Review of Policy Research*, 27(5), 595-619.
- [24] Njå, O., & Vastveit, K. R. (2016). Norske kommuners planlegging, gjennomføring og bruk av risiko- og sårbarhetsanalyse i forbindelse med samfunnssikkerhetsarbeidet [Societal risk governance in municipalities is based on a weak regulatory regime and unclear professional competence]. Stavanger: University of Stavanger.
- [25] Njå, O., Vastveit, K. R., Abrahamsen, E. B., & Eriksson, K. (2013). Evaluering av risikovurderinger i Statens vegvesen. Beslutningsstøtte og læringsverktøy. [Evaluation of risk assessments in the Norwegian Public Roads Authority: Decision support and learning tool]. Stavanger: International Research Institute of Stavanger.
- [26] Norwegian Maritime Authority. (2018). Amendments to the Regulations on qualifications and certificates for seafarers. NMA, RSR 05-2018.
- [27] Norwegian Maritime Authority. (2017). Information on certificates required to operate passenger ships at Svalbard. NMA, RSV 01-2017.
- [28] Norwegian Maritime Authority. (2019). Regulations on the construction, equipment and operation of passenger ships in the territorial waters surrounding Svalbard. NMA, RSR 03-2019.
- [29] Renn, O., Lindøe, P., & Baram, M. S. (2014). *Risk governance of offshore oil and gas operations*. New York: Cambridge University Press.
- [30] Ryan, F., Coughlan, M., & Cronin, P. (2009). Interviewing in qualitative research: The one-to-one interview. *International Journal of Therapy and Rehabilitation*, 16(6), 309-314. doi:10.12968/ijtr.2009.16.6.42433
- [31] Sandelowski, M. (2002). Reembodying qualitative inquiry. In (Vol. 12, pp. 104-115).
- [32] Solberg, K. E. (2017). Implications caused by SARex on the implementation of the IMO polar code on survival at sea. *IOP Conference Series: Materials Science and Engineering*, 276(1), 012017.
- [33] Solberg, K. E. (2020). Safety and emergency response associated with cold climate marine operations. Appendix 5, paper no. 10. (UiS PhD thesis no. 493). University of Stavanger, Faculty of Science and Technology, Department of Mechanical and Structural Engineering and Materials Science, Stavanger.
- [34] Solberg, K. E., Gudmestad, O. T., & Kvamme, B. O. (2016). SARex Spitzbergen : April 2016 : exercise report : search and rescue exercise conducted off North Spitzbergen (Vol. no. 58). Stavanger: University of Stavanger.
- [35] Solberg, K. E., Gudmestad, O. T., & Universitetet i Stavanger. (2018). SARex3: evacuation to shore, survival and rescue (Vol. no. 75). Stavanger: University of Stavanger.
- [36] Solberg, K. E., Skjærseth, E., & Gudmestad, O. T. (2017). SARex2 : Surviving a maritime incident in cold climate conditions (Vol. no. 69). Stavanger: Universitetet i Stavanger.
- [37] Svalbar Treaty. (1920). Treaty between Norway, The United States of America, Denmark, France, Italy, Japan, the Netherlands, Great Britain and Ireland and the British overseas Dominions and Sweden concerning Spitsbergen, signed in Paris 9th February 1920.
- [38] Sydnes, A. K., Sydnes, M., & Antonsen, Y. (2017). International Cooperation on Search and Rescue in the Arctic. *Arctic Review on Law and Politics*, 8(0), 109-136. doi:10.23865/arctic.v8.705.
- [39] The Barents Observer. (2018). Arctic cruise ship boom. Retrieved from <https://thebarentsobserver.com/en/travel/2018/05/arctic-cruise-ship-boom>