A Multi-Stakeholder Assessment on Shipping Risk Governance: A case study on the proposed ban on the use and carriage of heavy fuel oil by ships in the Arctic

by

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Table of Contents

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Abstract

Global interest in Arctic shipping is increasing as a result of melting sea ice and climate change. The potential risks of increased emissions, oil spills, and noise pollution can substantially affect coastal communities and commercial entities living and working in the Arctic. The International Maritime Organization (IMO) is the intergovernmental body that enables regulations on international shipping activities and is intending to ban Heavy Fuel Oil (HFO) in the Arctic. The IMO uses the Formal Safety Assessment (FSA) as a systematic cost-benefit assessment process to evaluate the risks associated with maritime safety and marine environmental protection and the cost-effectiveness of risk control options. The aim of the study is threefold: to assess the application of guiding principles, as described by the International Organization of Standardization 31000 Guidelines, in the IMO risk management process on marine environmental protection issues; to understand the rationale behind developing the ban on HFO in regards to the FSA; and to assess how stakeholders frame the risk problem of an HFO spill in the Arctic. The research analyzes and evaluates these three components of risk management (principles, method, and pre-assessment framing) to give an assessment on how they might affect high-level risk governance of shipping issues. Results show variance in application of principles in the IMO risk management process, befuddlement concerning the HFO ban development and methods used, and variance in how the risk problem was framed at the IMO. In order to proactively govern for emerging maritime and environmental risks due to increased shipping in the Arctic, this study discusses recommendations to address the resulting issues.

Keywords: maritime shipping, Arctic, heavy fuel oil, IMO, Formal Safety Assessment, risk governance, risk management

List of Tables

List of Figures

List of Abbreviations

AC	Arctic Council
AMSA	Arctic Marine Shipping Assessment
ASSPPR	Arctic Shipping Safety and Pollution Prevention Regulations
AWPPA	Arctic Waters Pollution Prevention Act
AWPPR	Arctic Waters Pollution Prevention Regulations
BC	Black Carbon
ECA	Emission Control Area
FSA	Formal Safety Assessment
HFO	Heavy Fuel Oil
IA	Impact Assessment
ICC	Inuit Circumpolar Council
IMO	International Maritime Organization
IRGC	International Risk Governance Council
ISO	International Organization on Standardization
MARPOL	International Convention on the Prevention of Pollution from Ships
MEPC	Marine Environmental Protection Committee
MKC	Maritime Knowledge Centre
MSC	Maritime Safety Committee
NGOs	Non-Governmental Organizations
NMTC	Northern Marine Transportation Corridors
NORDREG	Northern Canada Vessel Traffic Services Zone
NSIDC	National Snow and Ice Data Centre in the United States
PAME	Protection of the Arctic Marine Environment
PPR6	Subcommittee on Pollution Prevention Response (6th session)
PSSAs	Particularly Sensitive Sea Areas
RCO	Risk Control Option
SOLAS	International Convention for the Safety of Life at Sea
TC	Transport Canada
TSR	Transpolar Sea Route
UN	United Nations
UNCLOS	United Nations Law of the Sea
WWF	World Wildlife Fund

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Chapter 1. Introduction

Maritime shipping is projected to rise in the Arctic region in the coming decades (AMSA, 2009, Pizzolato et al. 2013 and Stephenson et al. 2018). Driven by climate change, the declining presence of sea ice has led to an increase of 75 percent in shipping activities in the Arctic (Pizzolato et al. 2013). Natural resource development, transportation of goods, and tourism, among other maritime activities, pose a governance challenge for stakeholders living, working, and gaining interest in the region. This escalation in Arctic shipping activity has the potential to generate economic benefits to local communities and outside industries, but also have widespread socio-ecological impacts on the marine and coastal environments (AMSA, 2009, Pizzolato et al. 2013, and Smith & Stephenson, 2013).

The leading United Nations agency in charge of regulating international shipping is the International Maritime Organization (IMO). According to the Mission Statement in the Strategic Plan 2018-2023, the IMO has the responsibility to provide safe and secure transit for all seafarers and protect the marine environment from ship-based pollution (International Maritime Organization (IMO), 2017a). Operating as a consensus-based forum, the IMO addresses risk problems related to any issue of maritime safety or marine environmental protection.

Currently, due to the projected increase in Arctic shipping, there is concern held by stakeholders of increased oil spill risk in the region (IMO, 2016 and IMO, 2017b). The key objective of this study is to provide recommendations for the risk management process at the IMO for ongoing and emerging maritime risk governance issues. To achieve this a multi-stakeholder assessment was conducted on the decision-making process for addressing the risk of Heavy Fuel Oil in the Arctic.

1.1. International and Canadian Risk Governance for Arctic Shipping

The growing opportunity for the maritime industry to access shipping corridors in the Arctic is creating maritime protection and safety issues at all governance levels (Standing Committee on Foreign Affairs and International Development, 2019). Economic development opportunities, such as natural resource exploitation and increased access for sealift services for northern communities, are among some of the outcomes that maritime shipping will attempt to advance (Young, 2009 and Prowse et al, 2009). These economic benefits have associated risks. To begin with, the Arctic environment poses operational challenges to ships, including navigation through unpredictable weather and ice conditions, low temperatures, and lack of complete maritime charts and infrastructure (DNVA, 2011 and Beveridge et al. 2016). These difficult conditions increase the risk of ship collisions or groundings, increasing the risk of an oil spill that could affect the fragile marine environment (Bai, 2015). The increase in shipping activities could disturb the wildlife, both terrestrial and marine, that indigenous communities depend on for traditional and cultural harvesting practices and food security (AMSA, 2009 and Beveridge, 2018). In order to mitigate shipping risks in the Arctic, the implementation of maritime risk governance, which is described as a multidisciplinary, multi-sectoral policy-making system to govern shipping activity and its consequences for all levels of society, is necessary (IRGC, 2009, van Leeuwen, 2015, and Bai, 2015).

Due to the nature of maritime shipping and the multiple jurisdictional areas crossed in a ships voyage, no solitary institution can manage and govern the sector (van Leeuwen, 2015). A wide range of stakeholders, including international, national, regional, local, and indigenous governments and agencies must be involved in the governance (Ritsema et al. 2015 and Beveridge, 2018). There are several different levels of governing bodies, legislations, and laws. On the international level, there is the United Nations (UN) specialized agency International Maritime Organization (IMO), which is the regulatory authority for international shipping with the responsibility for ensuring the safety, security, and prevention of marine pollution from ships. The IMO has put in place various governing regulations, such as the International Code for Ships Operating in Polar Waters (Polar Code) adopted January 1st, 2017, in order to improve the safety of shipping operations and mitigate negative impacts to the polar environment (IMO, 2015). The International Convention for the Prevention of Pollution from Ships (MARPOL) adopted in 1973 and 1978 is the overarching governing legislative mechanism that the Polar Code prescribes to (MARPOL, 2005).

At the national level in Canada, there is the Arctic Waters Pollution Prevention Act (AWPPA), under which the Arctic Shipping Safety and Pollution Prevention Regulations (ASSPPR) and Arctic Waters Pollution Prevention Regulations (AWPPR) are legislated. The AWPPA was adopted in 1970 and has set the tone for Arctic shipping legislation in Canada (Bartenstein, 2019). The Arctic Shipping Safety and Pollution Prevention Regulations (ASSPPR) legislates vessels operating within Canadian Arctic waters, coming into force in January 2018 (Bartenstein, 2019). This legislation applies to Canadian vessels operating in Arctic waters and has provisions on safety and marine pollution prevention measures. The ASSPPR aims to prevent any pollution risks in Canadian waters north of latitude 60°N through a governance regime (Canada Gazette, 2017). The ASSPPR covers topics such as ship construction requirements, ice navigation issues and planning, fuel and water concerns, and sewage and oil deposit mishaps, as is unavoidable in health and safety scenarios or ship damage from collision or stranding (Canada Gazette, 2017).

The International Organization of Standardization (ISO) is an international standard-setting body comprised of representatives from various national standards organizations (ISO, 2018). The ISO creates documents on international standards, guidelines, codes of practice, and management system standards (ISO, 2018). The ISO 31000:2018 Guidelines on Risk Management describe components of risk management and frameworks pertinent to successfully dealing with risk problems in an organization and making informed decisions. This edition of the ISO 31000 Guidelines was used as a basis for this study to assess the application of guiding principles in risk management processes at the international and national levels in the context of an exploratory case study on the proposed ban on Heavy Fuel Oil.

1.2. Heavy Fuel Oil in the Arctic

The majority of the global maritime fleet runs primarily on petroleum-based fuels. There are several variations of fuel for shipping, but predominantly there are two main categories: residuals or distillates (WWF, 2018 and Nelissen & Tol, 2018). Maritime fuels are derived from crude oil and refined and processed into different types. Products such as diesel, kerosene, and gas are distillate fuels that have been refined from crude oil (WWF, 2018). Residual fuels are products that have not been as refined as distillates and usually come directly from crude oils. Heavy Fuel Oil (HFO) is a term that describes the types of residual fuels used in the maritime sector. HFO is a denser, more viscous fuel type that is used by ships worldwide, as it is one of the cheapest fuel types on the market (WWF, 2018 and Comer, 2019). There are several different types of HFO presently being used by the maritime shipping sector, but it is generally referred to as a catchall term to describe the more viscous types of fuel used by ships.

Stakeholder groups such as non-governmental organizations (NGOs), Indigenous communities, academics and researchers are concerned that a spill of HFO in the Arctic will drastically affect the natural environment on which communities depend for their livelihoods (Pizzolato et al., 2013 and Nelissen & Tol, 2018). Industry stakeholders express similar concerns over the impacts a spill would have on the region and its attributes, emphasizing the importance of keeping the area clean and undamaged to continue economic development activities (CCA, 2016). In some instances shipping companies are pledging not to use Arctic sea routes due to the risk of impacting the marine environment from oil spills or marine mammal strikes, such as French container transportation firm CMA CGM ("CMA CGM Pledges", 2019). Other concerns about an HFO spill are related costs of cleanup, which could potentially fall under the responsibility of the local communities or local and regional authorities that may not have sufficient resources and funds to support a cleanup (Beveridge, 2018 and AMSA, 2009). Due to the chemical composition of HFO, a spill in the Arctic could lead to more severe impacts than when spilled in non-Arctic waters, leading to a complicated cleanup scenario, higher costs, and long-lasting damage (CCA, 2016 and Comer, 2019).

After reviewing several policy documents and reports on the issue submitted by member states and organizations, the Marine Environmental Protection Committee (MEPC) of the IMO agreed at the 71st meeting in July 2017 to include the output of developing mitigation measures to address the risk of an HFO spill in the Arctic in the succeeding agenda. They assigned the Pollution Prevention and Response Sub-committee (PPR) as the "associated organ" with two sessions to complete the work (IMO, 2017c). The proposed ban on HFO as fuel by ships in the Arctic as a mitigation measure was decided on at MEPC 72 in April 2018 by the Committee. Member states and organizations were invited to submit proposals on impact assessments for the following meeting (IMO, 2018b). The Impact Assessment draft methodology was decided on by MEPC after the first session of PPR 6 in February 2019 (IMO, 2019). The current parameters of the proposed ban of HFO in the IMO defined circumpolar Arctic do not include the carriage of HFO as bulk cargo.

1.3. IMO Risk Management and Formal Safety Assessment

Risk management occurs in several different manners at the IMO. There are two primary formal procedures: the Goal Based Standards (GBS) system and the Formal Safety Assessment (FSA) system. The GBS is a system that prescribes overarching goals to meet safety, security, and/or environmental requirements for ship construction and during a ship's lifetime (Hoppe, 2005). The Formal Safety Assessment (FSA) method is a proactive approach to risk management (Kontovas, 2009). The FSA is the prescribed methodology for conducting analysis on risks related to maritime safety and marine environmental protection and the conception of regulatory policy (Kontovas, 2009). According to the "Guidelines for Formal Safety Assessment (FSA) for Use in the IMO Rule-making Process", the document released as an IMO circular in 2002, the FSA is described as "a rational and systematic process for assessing the risks related to maritime safety and the protection of the marine environment and for evaluating the costs and benefits of IMO's options for reducing these risks" (IMO, 2002). The circular states it can be used in support of decision-making processes and for proposals for regulatory measures (ibid, 2002).

An FSA can be conducted by a Member State or an organization with consultative status with IMO, for reasons such as proposing amendments to IMO policy instruments or assessing proposals that may have "far-reaching implications in terms of either costs (to society or the maritime industry)" (IMO, 2002). IMO committees or subsidiary bodies can perform an FSA to provide input on regulation frameworks or to identify areas of concern with new proposals (ibid, 2002). There are five primary steps within the FSA. The steps of the FSA are laid out in figure 3 in Chapter 2 and a detailed description of the FSA steps, as adapted from the official IMO circular (IMO, 2018a), can be found in Chapter 2.

FSAs have been submitted to the IMO over the past few decades for various ship types, such as crude oil tankers, ro-ro cargo ships, and passenger ships, and for various risk problems such as routing measures, deck fire safety, and navigation safety, among many others. A quick scroll through the public access IMODocs website and one can find an FSA submitted by member states and intergovernmental organizations, and IMO secretariat reports on any amendments or comments made on them.

Some critiques of the FSA have noted deficiencies with applying the method to assess maritime safety and environmental protection issues. Kontovas & Psaraftis (2009) state problems with the transparency of the process; Psaraftis (2008) offers recommendations for expanding the reach of FSA on environmental risk evaluation criteria; and Devanney (2008) reveals subjective data input into an FSA can significantly alter the result of the risk assessment, affecting decisions made on the issue at hand. However, the FSA is an indirect way of achieving consensus on standards when agreement would otherwise be hard to come by at the IMO (Busby and Hughes, 2006). Having over 150 member states with their own perceptions of risk and value judgments on risk management makes it difficult for the IMO to reach agreement on particular regulations. The FSA is a process that allows for reaching consensus on the regulations by agreeing on the outcomes of the assessment (Busby and Hughes, 2006).

The International Risk Governance Council (IRGC) is an independent international think-tank organization that works on improving risk governance strategies for all fields. Working as a neutrally collaborative platform for risk experts, academics, and other stakeholders, the IRGC develops frameworks for risk governance and provides policy advice for decision-makers (IRGC, 2019). The IRGC Risk Governance Framework created in 2009 (updated in 2017) was used as a basis for this study. The concept of risk governance, risk characteristics, and risk categorization, all discussed in Chapter 2 of this report, were based off of information from the IRGC white paper report "Risk Governance – Towards an Integrative Approach" (IRGC, 2009).

Guiding principles for risk management are in place for the creation and preservation of value (ISO, 2018). Organizations of any size or purpose incorporate guiding principles into the operational risk management frameworks to ensure successful and effective longevity and progress. In order to proactively and consciously govern for current and future marine environmental protection issues in the Arctic, effective risk governance decision-making is necessary. Elements that could lend to that success could be derived from proper risk framing, application of underlying values and norms, and integrated management frameworks.

1.4. Scope, Purpose, and Objectives of this Paper

The management problem highlighted is as follows: The lack of clarity around how marine environmental protection risk problems should be pre-assessed and framed during the risk management process at the IMO leads to confusion among stakeholders and inconsistencies in overall risk governance. The lack of a standard, applicable risk-framing instrument for high-level decision-making on marine environmental pollution issues could create the possibility of governance problems for IMO member states in the future. This is highly problematic because risk management for Arctic shipping will only grow as the area gains more attention from local and global stakeholders. Although the IMO has the FSA to guide member states on conducting risk assessments, stakeholders find it unclear when or if to execute it for complex marine environmental issues. In addition, while the ISO 31000 Guidelines exist separate from the IMO, there is no standard framework for member states to follow belonging to the IMO to ensure guiding principles are being applied during the risk management process. If there are conflicts on which principles to apply, it is unclear as to which ones should be prioritized or how that should be decided.

The proposed ban on the carriage and use of HFO as fuel by ships in the Arctic is used as an exploratory case study. This topic is used to perform an assessment of multi-stakeholder views on the usage or non-usage of the FSA in the case of the HFO ban. By using the ban on HFO as a case study to understand the process of risk management in IMO decision-making, the project also aims to answer questions regarding the underlying values and risk framing process for regulating shipping risks in the Arctic and the broader context of climate change.

Methods used in this project include a literature review and a comparative analysis of semi-structured interviews. This paper begins with a detailed literature review on the current situation of Arctic shipping risk governance, HFO use in the Arctic, and the current status of using FSA for marine environmental protection issues. The review also includes an analysis of information on risk framing, risk management, and risk governance, particularly related to Arctic shipping. The stakeholder interviews proceed to be the major purpose of this paper; they are used to assess the views on the HFO ban from three main stakeholder groups (Arctic Council member states, industry, and NGOs) and to evaluate how the framing of the issue delivers different outcomes for risk management through the different avenues of framing. The objectives of this study and report are: (1) to identify the scope of application of the ISO 31000 Guiding Principles in the context of marine environmental protection issues at the IMO; (2) to identify why the FSA was or was not used in the case of the proposed ban on the use and carriage of HFO as fuel in the Arctic and the reasoning behind this decision-making; and (3) to categorize different stakeholder views on the framing of the HFO risk and compare any discrepancies in this phase and ascertain how it affects shipping risk management and governance, based on the IRGC's pre-screening definition. The case study on the proposed ban on HFO served as an exemplary analysis to inform the recommendations provided in this study. This report provides a basis for understanding multi-stakeholder views on the guiding principles in risk management and governance at higher levels. This study can be used in future projects intended to help the process of risk management and governance of Arctic shipping issues.

Chapter 2. Context & Literature Analysis

This chapter discusses pertinent aspects of the research. First is an overview of the risk theory and practice concerning governance, management, and assessment of the discipline. Important differences between the three are discussed. Secondly, the guiding principles of the ISO 31000 Guidelines are discussed and differences between risk management principles and risk governance principles are explained. Following that is a review of the Formal Safety Assessment and Impact Assessment methodologies and how they differ. Context on the changing Arctic environment and related challenges follow. Finally, overviews of the governance structures both internationally and in the Canadian context are briefly discussed. The aim is for the reader to progress through the report with a knowledge base when reading through the results of the study.

2.1. Risk Governance, Risk Management, and Risk Assessment

Without delving too deep into the epistemological theory behind risk, a brief overview is needed in order to discuss the basis and findings of this study. Scholars and risk practitioners define risk in varying ways, but for the purpose of this paper, Rosa's (1998) definition will be used: "risk is a situation or event where something of human value (including humans themselves) has been put at stake and where the outcome is uncertain." This definition is chosen for the straightforward explanation and lack of jargon. It is important to note that the different components of this study, such as the IRGC and FSA, define risk differently. However, this definition states the ontological origin of risk and includes three key factors relevant to the conceptions of risk.

First, it states the human interest, secondly it states an outcome could occur, and thirdly that the outcome is uncertain (Rosa, 1998). All of these are elements of how risk perception plays out into reality. Risks are mental constructs (Rosa, 1998 and IRGC, 2009). There are no actual risk problems in the world, but with the inclusion of the human dimension and how either something of human value or humans themselves could be affected by an uncertain outcome, that is how risk is transformed from being non-existent to possibly realistic (IRGC, 2009 & Rosa, 2010). For example, the risk of an HFO spill in the Arctic would not exist if humans did not place value on the lands, waters, resources, and health connected to or drawn from the region. It is only because of this value placement that the idea of an oil spill or the emission of greenhouse gases becomes an actual risk in need of governance and management.

In order to discuss the implications of this study in the field of high-level risk governance, this section provides context on what risk governance, risk management, and risk assessment represent in relation to this study. The content in this section was gathered from an intensive review of risk management and governance literature, as well as literature on Arctic shipping, heavy fuel oil, and governance frameworks for International and Canadian milieus.

2.1.1. Risk Governance

Risk governance is the practice of applying governance principles to identify, assess, manage, and communicate risk through all avenues of actions, process, and institutions to inform management decisions (SRA, 2018). Risk governance includes actors, conventions, rules, and mechanisms that are concerned with how the risk information is analyzed, communicated, and managed (SRA, 2018 and IRGC, 2009). In situations where there is no single authority to decide on a risk management decision, collaboration is needed between different stakeholders (IRGC, 2009). A final key element of risk governance is the recognition of contextual factors such as institutional arrangements and political cultures with different perceptions of risk (ibid, 2009 and Aven & Renn, 2018). These contextual factors can lead to different manners in how organizations and societies manage risk.

The International Risk Governance Council (IRGC) risk governance framework is broken into four main phases: pre-assessment, risk appraisal, risk evaluation and characterization, and risk management (IRGC, 2009). Communication is linked to each phase to show the importance of clear communication of risks among different actors, stakeholders, agencies, and levels of society. Although the framework represents the cyclical nature of risk governance it is divided into two spheres: the first is the generation of knowledge needed for the overall assessment and characterization of risk; and the second is the management sphere, representing the decision-making steps and implementation of actions. Integrating scientific, economic, social, and cultural aspects, the framework also includes the effective engagement of stakeholders (IRGC, 2009).

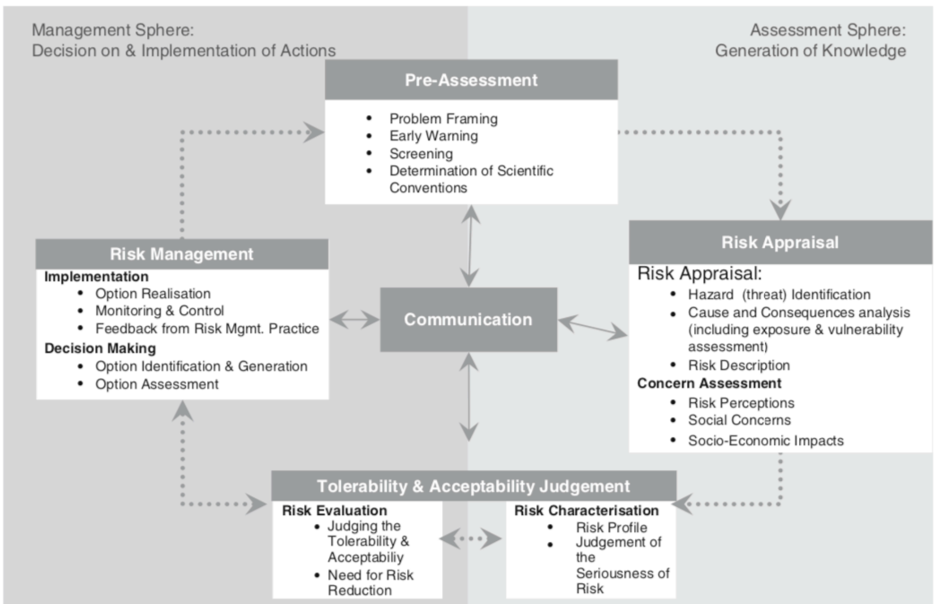

Figure 1. The IRGC risk governance framework (IRGC, 2009).

The first step of the IRGC framework, Pre-Assessment, is to objectively capture the variety of issues stakeholders (and society) associate with certain risks. This includes existing indicators, routines, and conventions that could be addressed by the risk. This step is called “risk framing”, an important first step to achieve in order to align the views of stakeholders on the management of the particular risk (Jonsson, 2011). Differences in perception must be acknowledged in order to reach a common understanding in what generates the risk and how to approach a mitigation or control strategy (IRGC, 2009). Tasks commonly taken in this step include pre-screening, early warning, and problem framing. This study conducted research on the problem-framing phase of the pre-assessment step in risk governance.

Risk Appraisal is the second step in the framework and is essentially the phase which provides the knowledge base for decision makers on whether management of the risk is needed, and if so, how to moderate or contain the risk (IRGC, 2009). This step commonly involves risk assessments, stakeholder concern assessments, and impact assessments on the socio-economic landscape related to the risk (ibid, 2009). The objective of this step is to have an evidence-based platform from which to inform decisions on how to approach the risk. These two first steps, pre-assessment and risk appraisal, are within the Assessment Sphere, which has the primary objective of generating knowledge in order to deal with the risk (ibid, 2009).

The third step, Risk Judgement, is partially between the first sphere and the second sphere, which is focused on management and implementation of the risk. It aims at judging the acceptability and tolerability (related to risk levels, discussed further on) of a risk. The judgement is informed by two distinct knowledge-building efforts: the risk characterization and risk evaluation (ibid, 2009). As per the IRGC's description "while risk characterization compiles scientific evidence based on the results from the risk appraisal phase, risk evaluation assesses broader value-based issues that also influence the judgement" (ibid, 2009). This third step will guide the management process on which risk control options are necessary for dealing with the risk problem.

The fourth and final step, Risk Management, will realize the implementation of actions and solutions to address risks. Risk control options, option assessment and decision making, and monitoring and feedback are among some of the key steps that are carried out during this step (IRGC, 2009). Risk control options are assessed for effectiveness, efficiency, sustainability, and minimization of external side effects (ibid, 2009). A value judgement, based on guiding principles, is made on the assessment criteria to consider the next decision made on the risk control options (ibid, 2009). A risk trade-off analysis is usually made after this step to provide information on best choice scenarios, and then a decision is made. Following this, monitoring of that risk control option occurs with follow-up evaluation processes to inform similar risk scenarios.

An important fifth step, more of a crosscutting aspect of the framework, that is connected and ongoing during each of the above four steps is Risk Communication. This is the process of informing stakeholders and civil society on the rationale behind the results and decisions made for the risk management. According to the IRGC (2009) "effective risk communication fosters tolerance for conflicting viewpoints… and creates trust in the institutional means for assessing and managing risk and related concerns." Poor risk communication can significantly affect stakeholders and civil society in coping with risks, so it is paramount that risk communication is thoroughly achieved. The exchange of information across all interfaces—between risk managers and assessors, policymakers and scientists, and governmental institutions to public society—is a crucial element in the risk governing process (IRGC, 2009).

The IRGC Risk Governance Frameworks includes a categorization of risks into four main categories. These categories describe the types of risks addressed, the type of stakeholder input and participation required, and type of management strategy that is appropriate for the classification of risk. According to the 2017 IRGC report, the categories are prescribed at the third step of risk characterization and evaluation and management plans from the categories are selected during the fourth step of risk management (IRGC, 2017). In the IRGC 2009 report however, the categorization of risk appeared to be in the first step of Pre-assessment. Nevertheless, the four categories do not change much between the two iterations of the report and are defined as: simple, complex, uncertain, and ambiguous. Figure 2 shows the different aspects related to each risk category, as described by the IRGC (2009 and 2017) but a short description is as follows.

Simple risk problems require management strategies drawing on traditional decision-making instruments, such as risk-benefit analyses, cost-benefit studies, and implementation of risk reduction measures to address the risk problems (IRGC, 2009). Common examples of simple risks are car accidents, food and health risks, and regularly reoccurring natural disasters. Complex risk and uncertain risk problems can be categorized by a difference in strategic approach: complex focusing more on robustness and risk-informed strategies and uncertain focusing on resilience and precaution-based strategies (ibid, 2009). As described by the IRGC (2009) "robustness" in the context of cybernetic risk management is the numerical results' insensitivity of to small changes and "resilience" is the characterization of an entire system's insensitivity against surprises.

Complex risk problems customarily involve acquiring complete data sets and concern assessments to decrease vulnerabilities. The IRGC framework emphasizes the importance of improving the "reliability and validity" of results to provide a factual basis for risk managers and decision makers to inform best practices (ibid, 2009). Uncertain risk problems are characterized by a high level of uncertainties remaining with the data and knowledge of the risk and require a precautionary approach for dealing with them. Uncertain risk problem takes on containment strategies to gradually deal with the risk and assess the ALARP (as low as reasonably possible) scenarios.

The final category of risk problems is the ambiguous variety. The IRGC (2009) describes ambiguous risk problems as needing a discourse-based strategy (all levels of stakeholder and agency input) to create tolerance and mutual understanding on views and with the aim to reconcile them. When multiple stakeholders interpret risk information differently and controversy arises about what should be protected or reduced, the risk management needs to prioritize the amelioration of what is causing the conflicting views (ibid, 2009). Strategies for ambiguous risks focus on participative discourse for stakeholder participation, from agencies to external experts and directly affected groups to civil society representatives (Klinke and Renn, 2002).

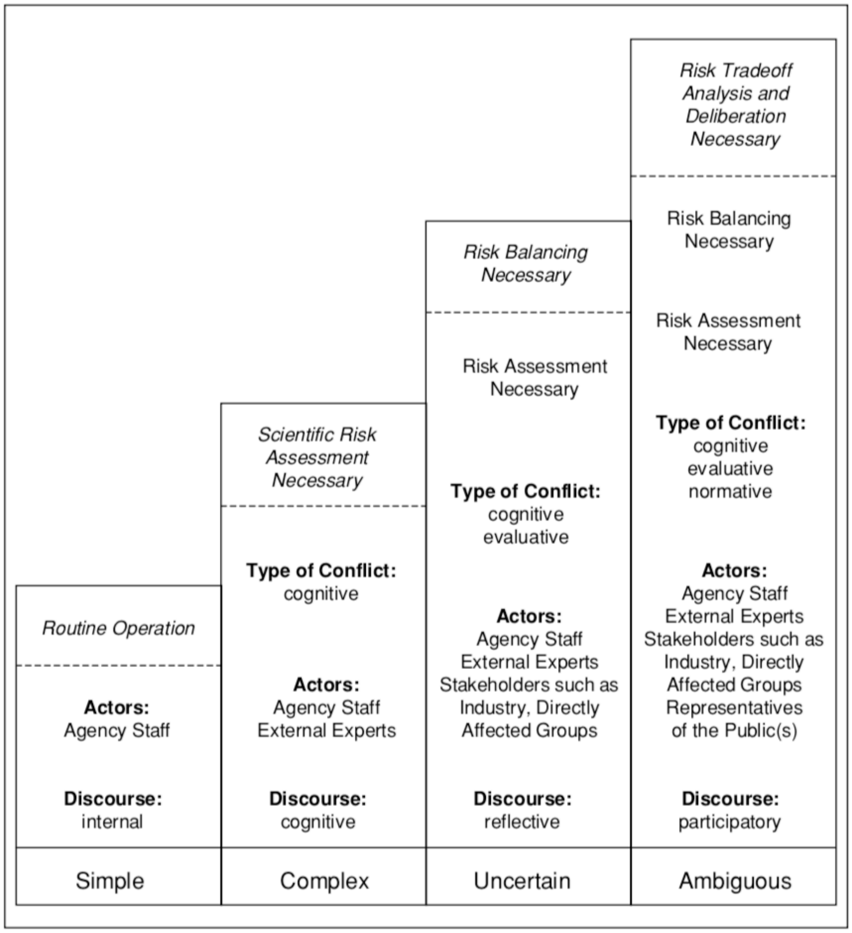

Figure 2. Risk categories described in Klinke and Renn's 2002 diagram and IRGC Risk Governance framework from 2009.

In the risk governance realm, there are generally three main strategies for managing risk: risk-informed, precautionary, and discursive (Aven and Renn, 2018). The risk-informed strategy involves the avoidance, reduction, transfer and retention of risk by primarily using risk assessments. The precautionary approach intends to highlight the robustness and resilience of a risk management option while aiming to increase knowledge and subsequent options. The discursive strategy prioritizes the reduction of uncertainties, involvement of all affected parties, and clarification of facts to build a confident and trustworthy environment in addressing the risk at hand (Aven and Renn, 2018). If thinking about the categorization of risks, it's clear to see the connection between each type of risk classification and appropriate risk strategy. Risk-informed for simple risk problems, precautionary strategy for complex and uncertain, and discursive for the ambiguous risk category. Aven and Renn (2018) argue that a mixture of all three of these management strategies is necessary for addressing any type of risk problem. There would be a varying degree of each strategy applied to the type of risk problem, but it would increase the likelihood of managing the risk problem in an efficient manner.

2.1.2. Risk Management

Risk management is the concrete process that is taken to avoid, mitigate, or remove a risk from affecting different aspects and levels of society. The SRA (2018) defines risk management as "activities to handle risk such as prevention, mitigation, adaptation or sharing. It often includes trade-offs between costs and benefits of risk reduction and choice of a level of tolerable risk." The risk management process aids decision makers by accounting for the uncertainty and possibility of events and their unintended or intended effects (IRGC, 2017). The same three strategies mentioned above by Aven and Renn (2018) for risk governance are applied in risk management (Aven, 2016). Risk management usually includes logical and systematic methods for communicating about the risks, establishing the context for all aspects of management (identifying, treating, analyzing, evaluating), monitoring and providing reviews (Aven, 2016).

According to Aven (2016), risk management is similar to policy and policy analysis. Policies can be seen as tools to protect what is valued by society. The steps in policy analysis are similar to those in risk management: problem identification, alternative analyses, policy development, decision-making, and implementation and evaluation. The cycle, like in risk management, is iterative and intended to continue improving upon the decided policies.

In regards to risks to the Arctic via maritime shipping, risk management at the IMO attempts to be integrative of all aspects of the organization to deliver the best alternatives. It attempts to combine the best available scientific evidence with economic considerations from member states as well as social concerns and values. Due to these factors, the organization gets some backlash on promptness of risk management and application of policy measures to safeguard the marine environment.

2.1.3. Risk Assessment

In the IRGC framework risk assessment falls under the first step of risk appraisal. Risk assessments are those "systematic methods" mentioned above under Risk Management. They are described by the SRA (2018) as systematic processes used to comprehend nature of risks and to evaluate the risk with all available and relevant knowledge. Steps considered for a risk assessment usually include pre-assessment, which contains problem framing, early warning signs, risk estimation, and screening (IRGC, 2009). Risk framing is the dominant perspective to the object at stake. It is different from risk perception, which is usually assessed in concern assessments of stakeholders in how they perceive the risks. Risk framing influences what is put on the agenda for management and becomes part of the discourse and public debate (Jonsson, 2011). Risk assessments provide decision support in choosing between different options.

2.2 Guiding Principles

This research looks into how the underlying principles of risk management direct decision-making at IMO using the ISO 31000 guidelines. These guidelines are a standardized way that informs organizations on how to perform risk management effectively. Principles are value judgements that everyone places on processes and operations. According to ISO (2018) guiding principles affect leadership directives and outcomes that then affect processes such as risk assessments, which have working frameworks. They provide a foundation that can direct managers and experts to implement efficient and effective risk management while clearly and transparently about the process. Guiding principles should enable an organization to manage the effects of uncertainty on its objectives (ISO, 2018). A complete description of the ISO 31000 Guiding Principles can be found in Appendix B.

The guiding principles of the ISO 31000 Guidelines differ slightly from the principles of governance discussed in the IRGC risk governance framework. The IRGC (2009 and 2017) lists similar principles but they are broader in scope and application to match the principles of good governance, not just management. Principles of good governance include "transparency, effectiveness and efficiency, accountability, strategic focus, sustainability, equity and fairness, respect for the rule of law, and the need for the chosen solution to be politically and legally feasible as well as ethically and publicly acceptable" (IRGC, 2017). These principles encapsulate the notion of governance as the entire mosaic of actions, processes, traditions, and institutions at the global level. The ISO 31000 guidelines are used for this research to assess the principles of *risk management* and how it occurs at the IMO, which then transpires into higher-level maritime *risk governance*. The degree of application of the guiding principles at the IMO risk management processes has implications on global governance of shipping and maritime issues, and it is essential managers and decision makers move forward with this information in a time of changing Arctic circumstances.

2.3. IMO Formal Safety Assessment and Impact Assessment

As mentioned above in Chapter 1, the Formal Safety Assessment (FSA) is a rational and systematic process for conducting risk assessments to give decision-makers the best options for mitigating, avoiding, or reducing risks. The objective of creating the FSA was to have a clear and transparent process that could create new or evaluate existing regulations based on hazard identification, probability sequences, consequences, and cost effectiveness, with the overall aim of comparing the alternatives (Hermanski and Daley, 2010). The fundamental aim of the FSA is to improve or protect seafarers, ships, and the marine environment. The FSA consists of five steps, shown in figure 3.

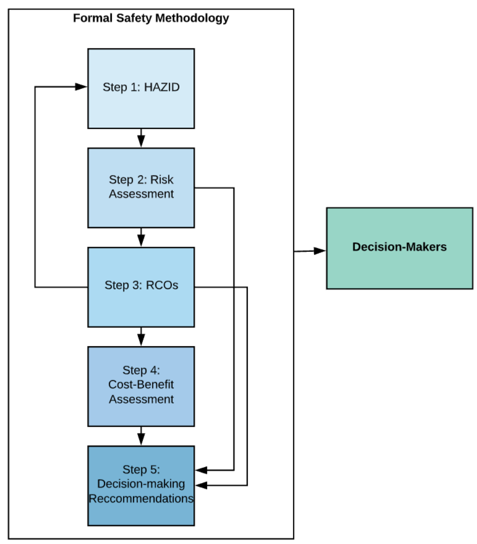

Figure 3. Formal Safety Assessment Methodology and respective linkages between steps Perhaps more environmental risk criteria should be developed for the FSA on these marine issues. (Source: author)

A brief description of the steps is as follows. Step 1 is Hazard identification, and like many other risk assessments, it is conducted to list all potential hazards that may pose risks to the area in question and prioritize these by significance. Step 2, the risk analysis, is the detailed investigation of the most important risk scenarios identified in Step 1. Fault trees, event trees, and other standard risk assessment techniques are used to build risk models which then provide a basis of risks needing to be addressed. Step 3 is to propose effective risk control options by focusing on risk areas needing control and practical measures to reduce existing and potential risks introduced. Step 4 is the cost benefit assessment, which compares the costs and benefits of each risk control measures identified in Step 3. The final step is the recommendation of actions for decision makers to address the risks with relevant background information, plausible scenarios, and risk control options with associated cost benefits (IMO, 2002).

Numerous FSA studies have been conducted which have resulted in shipping regulations. Examples include (Risk Control Options) RCOs regarding life saving appliances for bulk carriers and RCOs for navigational safety of large passenger ships. FSAs have been used to improve crew training, enhance survey and inspection, enhance and implement port security inspections, and introduced double hull design requirements and specifications (Hermanski and Daley, 2010). Although many risk management options and IMO regulations have been discerned from FSA studies, there still remain issues with the process. In general the process is viewed as costly and time consuming, which can slow down the decision making process. Hermanski and Daley (2010) state that it can take upwards or over a year to finalize an FSA, which could deter users for wanting a faster process. This puts pressure on the risk management process as societal participants look for fast solutions in dealing with risk. The FSA can be manipulated via the type of data used for the study. Konovas and Psaraftis (2009) mention the type of data can significantly influence the outcome of the FSA. For instance, in Step 1 of Hazard Identification, if historical data is used instead of causality analyses data to draw conclusions on the risk profile then that is fine to a certain extent. The issue with using historical data and limited model analyses the FSA is not as proactive (which is an intended attribute of the tool) and cannot be applied to create new designs or measure effects of newly implemented RCOs. It is relying on accident data to be inputted, which is the very antithesis of a proactive risk management process. This issue with the first step then trickles down the line, into risk analysis and RCO recommendations, which would not be accurate for the situation in real time. However, Aven (2016) argues that a pure probabilistic approach—not including any historical data in the risk assessment process—would be equally as insufficient in results. In the case of Arctic shipping issues, it most likely is best to have a mix of data for the assessment to derive the most robust results.

Another criticism of Konovas and Psaraftis (2009) on Step 3 is with the RCOs, noting that FSA studies have based their decision-making recommendations on only one RCO, when a variety of Risk Control Measures (RCM) should make up groupings of RCOs for different options. A final general critique is that FSA studies have not been as transparent as the should be, leading to confusion among related participants and being unable to explicitly justify proposed measures (Konovas and Psaraftis, 2009 & Konovas and Psaraftis, 2006). It is important to keep in mind that the FSA process is not designed to produce final answers. It is designed to produce the best options for risk control measures, which should then be grouped into Risk Control Options (RCO) to advice decision makers on the best possible course of action for addressing the risk problem (Kontovas and Psaraftis, 2006, & Hermanksi and Daley, 2010).

No FSA study was conducted on the risk of HFO use in the Arctic. After the decision was made to propose a ban on HFO (as described in section 1.2) the working group devised the Impact Assessment (IA) methodology to assess the impacts of the ban on member states. Appendix A contains the full official IMO impact assessment methodology, but a brief description of the steps is as follows. Step 1 is to define the scope; the aim being to analyze impacts on social, environmental, economic factors. The objective is to fully assess adverse and beneficial impacts on Arctic indigenous and local communities, industries, economies and coastal and marine ecosystems. Step 2 is to define the policy objective – due to the MEPC 71 output of developing new measures to reduce risk of HFO in Arctic, policy options must be able to reduce the risk and must be able to do this in the near term. Policy options must be assessed for impacts but also for how effective they are in solving the defined problem within an appropriate timescale. Step 3 is divulging policy options; impact assessments should consider the identified policy options of implementing a ban on an appropriate timescale or implementing a ban with "other factors incorporated". Step 4 is to perform a cost-benefit analysis of the ban to local communities, industries, economies, and geographical/marine features. Finally, Step 5 is the comparison of policy options and recommendations for preferred option(s) – focusing on the two options mentioned in step 3 (IMO, 2019, Feb 21, Annex 2).

When devising the methodology for the impact assessment the working group discussed what policy options should be included. Although some delegations viewed Step 3 as the place to list other policy options, the working group decided that options only including the ban should be listed, giving the only option of developing a ban on the basis of the impact assessments (IMO, 2019, Feb 21). The working group also decided on the IA methodology to be a guidance document, not a prescriptive directive text in which all member states related to the issue must submit one. This would allow for member states to follow the methodology but include or exclude parts that were relevant to each state. The Working Group agreed that MARPOL Annex I would be the most appropriate instrument for a ban on HFO in Arctic waters (IMO, 2019, Feb 21).

The differences between the FSA and the IA methodologies are distinct in that the FSA is an assessment of risk based on data to inform decision makers on control and mitigation measures whereas the IA is an assessment based on data to inform decision makers on the impacts of selected policy options. Because no FSA was conducted on the risk of HFO in the Arctic, there are no other RCOs offered by member states to deal with the risk problem. The IA is limited to the two options of implementing a ban or implementing a ban with caveats (which are undisclosed currently), permitting the IMO to solely focus on these options. Regardless of whether member states submit impact assessments, it appears the IMO will continue to move forward with the decision and implement the ban by 2021 (IMO, 2019, Feb 21).

2.4. Arctic Shipping, HFO, and Climate Change

Sea ice coverage in the Arctic has been changing gradually over the past several decades. In 2007 one of the lowest September sea ice coverage was recorded 23 percent below the 2005 average (Stroeve et al. 2012 and Wang et al. 2009). In 2012 the National Snow and Ice Data Centre in the United States (NSIDC) recorded another all-time low ice coverage in September, showing sea ice covering only 24 percent of the entire Arctic Ocean (Chircop, 2014). As of this year, the NSIDC recorded September 2019 as the third lowest Arctic sea ice coverage period in the entire 41-year dataset, behind 2012 and 2007 (NSIDC, Oct. 3, 2019). Many scientists predict that with a continuation of this trend the Arctic will be ice free in summer months as early as 2030 (Holland et al. 2006). Both Stroeve et al. (2012) and Wang et al. (2009) predict through modeling that the arctic could be ice free in the summer between 2028-2037. Figure 4, from the Arctic Institute in 2016, shows the extent of change in sea ice coverage over the next century. If this phenomenon occurs, it will allow for an increase not only in transnational shipping, but also development and exploitation of natural resources (oil and gas and mining), fisheries, and military operations (Standing Committee on Foreign Affairs and International Development, 2019).

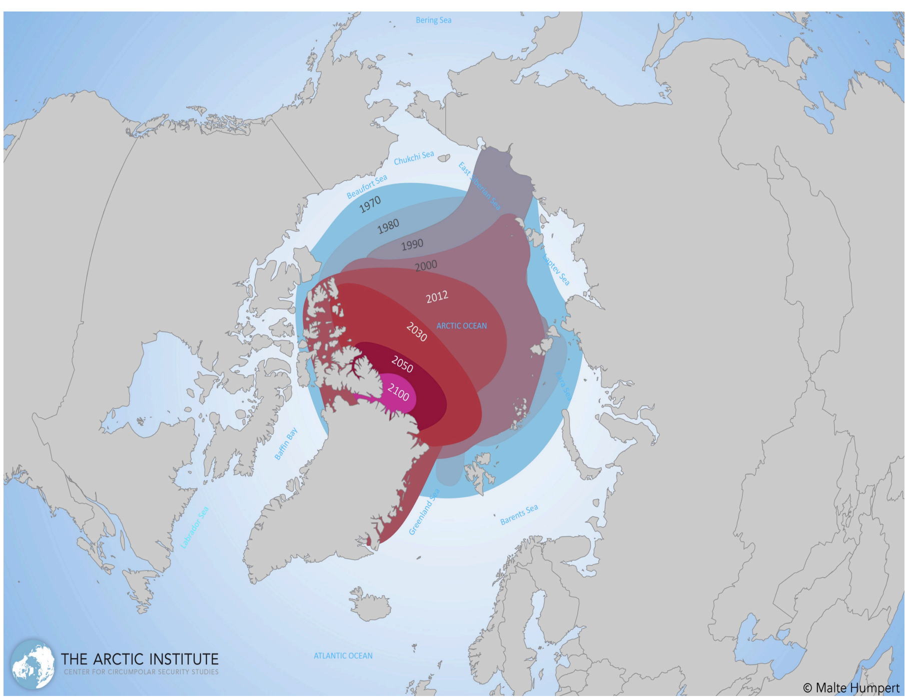

Figure 4. Projection of summer sea ice melt (The Arctic Institute, 2016).

Shipping emissions occurring in the Arctic are significantly less compared to what is emitted from major transnational shipping routes currently, however the implications that they could have in the Arctic should be studied and understood for future risk management (Council of Canadian Academies, 2017). Shipping activities emit GHGs, such as CO2, NOx, and SOx, which all contribute to climate change impacts, implications for food security, and negative health impacts (Schroder et al. 2017). Studies show that emissions released in the Arctic react differently than in sub-polar regions and can cause irreversible changes to critical processes necessary for climate regulation (Aliabaldi et al. 2015).

The burning of HFO releases chemicals that are called "short-lived climate forcers" (SLCF), pollutants that significantly contribute to climate forcing (Smith and Stephenson, 2013 and Corbett et al, 2010). These pollutants are classified as short-lived due to their short lifespan within the atmosphere. Black carbon (BC), a particulate matter that is classified as an SLCF emitted by ships primarily from burning HFO, contributes to regional climate effects by interacting with ice and snow (Corbett et al. 2010). The rates of BC emissions in the Arctic are expected to increase by a factor of 3 to 5.3 by 2050 "under business-as usual and high-growth scenarios" according to Aliabadi et al. (2015) and Corbett et al. (2010). The emission of BC in the Arctic is known to have a positive feedback loop where it increases the rate of sea ice melt by decreasing the regional albedo, an important element in global temperature regulation (Schroder et al. 2017 and Stephenson et al. 2018). Figure 5 from the NSIDC shows the extent of sea ice coverage as of October 2019, with a median range for years 1981 to 2010. Alternatively, Stephenson et al. 2018 argue that the effect of BC in the Arctic may have the opposite affect and instigate a regional cooling of -1 C° due to the creation of clouds with high liquid content, decreasing the absorption of solar radiation. To date there is not enough scientific evidence to show whether this will be true, but regardless the case, international shipping governance will have to manage for the increase of shipping activity and related impacts.

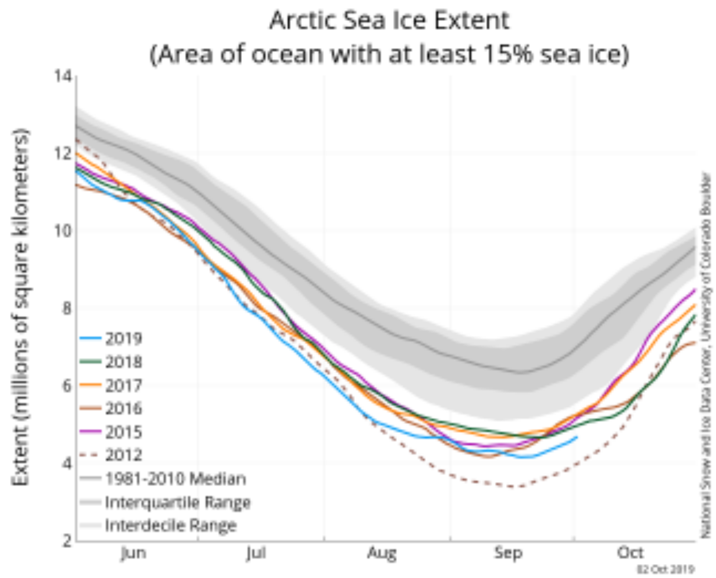

Figure 5. As described by the NSIDC, the graph shows Arctic sea ice extent as of October 2019, with record low years in coloured lines and the 1981-2010 median in dark grey (NSIDC, 2019).

There are technological and operational solutions to mitigating GHG emissions from ships, as well as regulatory policy, such as the newly adopted sulphur emission limit of 0.5 percent in 2020. Operational features, such as slide valves, particulate filters and scrubbers, and energy efficient engine designs, offer solutions to reduce emissions that are somewhat cost effective (Corbett et al. 2010). Creating special designations of the ocean to regulate shipping emissions is another tactic of reducing the impacts of emissions. Emissions Control Areas (ECAs) are specially designated areas of ocean that ships are prohibited to exceed in emission content. An ECA is prescribed by the IMO through MARPOL Annex VI after a regulated assessment process. There are currently four major ECAs: The North Sea, the Baltic Sea, the North American coastline, and the US Caribbean ECA (Linstad et al. 2015). For this research it was explored whether the Arctic should be designated as an ECA in order to help reduce the projected emissions related to the increased shipping projections. Results are discussed in Chapter 5. An additional sea area designation that is available is the Particularly Sensitive Sea Areas (PSSA), which are intended to protect ecologically and culturally significant ocean areas by regulating the maritime activities through MARPOL. Adding specific measures, such as equipment requirements by ships, discharge regulations, and installation of Vessel Traffic Services (VTS) aid in controlling the affects shipping might have on this socio-ecological important area. Regions designated under PSSA include the Great Barrier Reef, Galapagos Islands, and the Wadden Sea (IMO, 2006). The PSSA could potentially be another policy option for ensuring the protection of certain Arctic regions, as it is home to a culturally diverse group and unique and fragile ecosystems.

2.4.1 Increased interests, challenges, and risks

This section provides an overview on some of the main development and trade activities that are projected to grow and become more prominent in the Arctic region. Shipping is a tool for international trade and international trade activity is only going to increase in the coming decades (Beveridge et al. 2016 and Lu et al. 2014). Existing governance structures and frameworks will need to be modified to accommodate for the increase in international trade that will occupy the Arctic region, either via shipping routes or new development projects. Among the Arctic sea routes, the Northwest Passage (NWP) in Canada is hypothesized to become a new go-to transit route for the shipping industry, as it will be much shorter than using current routes, such as the Panama Canal (Lu et al. 2014 and Lindstad et al. 2016). Questions on sovereignty and security abound regarding the high influx of ships on these routes.

Non-Arctic states are showing more interest in using the Arctic as a transit way for their ships or exploring for natural resources. Countries like China have already begun claiming rights to the area by declaring themselves “near-Arctic States”, in order to assert control in the situation. China has stated many times in media that it intends to use the Arctic as a new “Polar Silk Road” (Standing Committee on Foreign Affairs and International Development, 2019). Although China and other Asian states have their views pointed north, the presence is still minimal compared to Arctic state flags such as Russia. There has been noted increase in military presence from the Russian Federation in the Arctic region. Russia’s interest in establishing a greater sovereign presence in order to ensure the development of future industrial projects and for military experimentation is an intergovernmental and political situation that requires much collaboration (ibid, 2019).

The presence of various indigenous communities all around the Arctic also inserts a crucial aspect into the governance of the region. The Artic Council includes six indigenous peoples’ organizations in the Council, yet there is a lack of indigenous presence at the IMO. Increased participation by these members will be necessary for the coming governance scheme of the Arctic to ensure their rights and voices are heard on topics such as shipping risks, military involvement, and further natural resource development.

There are anticipated increases in natural resource exploitation in the Arctic. Oil reserves have been estimated to be roughly 50 billion tones existing in the North close to Siberia and in the Barents Sea, according to the US Geological Survey in 2011 (DNVA, pg. 16, 2011).

The AMSA report of 2009 stated the estimated volume of transshipped oil and gas would be about 40 million tones by 2020. Ores and minerals are another large development interest. The Red Dog mine in Alaska has been operating since 1989 as the world's largest zinc mine, with iron ore being mined in Finland and copper in Northern Norway (DNVA, pg. 17, 2011 and Lasserre, 2011). The Northern Sea Route (NSR) is estimated to be approximately 30-40 percent shorter than the route via the Suez Canal for ships travelling from Yokohama to Hamburg (DNVA, pg. 18, 2011, Lindstad et al. 2016, and Lasserre, 2015). Most of the bulk maritime traffic is linked to the transportation of these natural resources in and out of the Arctic region. The second half of the commercial activity is supplying northern communities (AMSA, 2009). Cruise traffic is an up and coming industry in the region. Many of the cruise ships observed in the Arctic are not of ice safety standards, still made for open waters and warmer climates (AMSA, 2009). Cruises such as the Crystal Serenity that voyaged along the NWP in 2016 had icebreaker accompaniment to ensure it was able to transit successfully through, even in the warmest months (Clark and Ford, 2017). Among the other sea routes are the Arctic Bridge Route, from Scandinavia to the Hudson Bay and the Transpolar Sea Route, which would cut nearly directly over the North Pole in the Arctic during ice-free summers. Figure 6 depicts all four major routes as imagined currently.

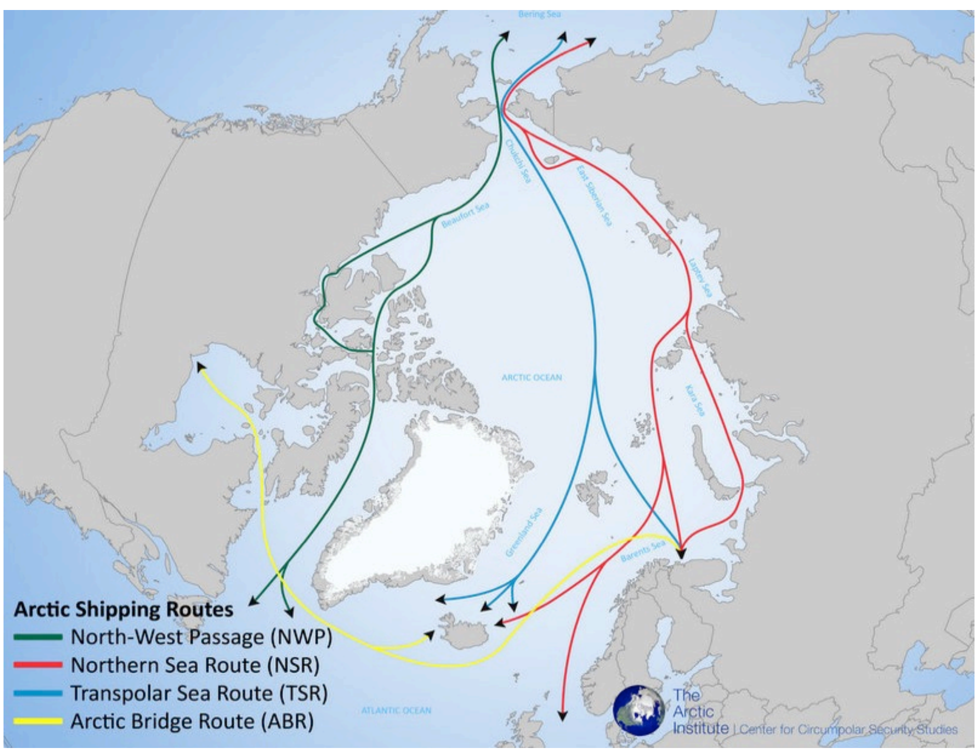

Figure 6. Potential Arctic Shipping Routes (The Arctic Institute, 2016)

There is a lot of hype in the media (and governmental reports) about non-Arctic member states wanting to send their ships up and through the Arctic, creating concern among stakeholders. Beveridge et al. (2016) surveyed over 140 Asian shipping companies to assess the level of interest in using the Arctic as a transit way. Their results showed that although there is increasing interested among Asian states, a minority of shipping companies are actually prepared or even thinking of venturing into the Arctic. The majority of this interest is in destinational travel for LNG transportation from the Yamal plant in Russia, rather than transit shipping. This shows that the media excitement seen regarding the Arctic opening up as a highway in a few years to non-Arctic states is not reflected in real life. This does not mean that Asian shipping companies will remain stagnant in their pursuit of using Arctic sea routes; rather it will most likely be decades before we see a mass influx of these flag states sending ships in, and when it happens it will likely be more calculated and regulated than anticipated via the media.

2.5. International Governance for Arctic Shipping

The International Convention for the Prevention of Pollution from Ships (MARPOL) is the international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes (MARPOL, 2005). Originally adopted in 1973 as a convention, the IMO created the MARPOL Protocol to deal with several tanker accidents before the convention entered into force. The combined document is now referred to as MARPOL 73/78 and has been amended over the past decades. There are six main regulation annexes of the convention, all dealing in some facet of marine pollution. The HFO ban proposed by the IMO would be implemented by an amendment to Annex I, Regulations for the Prevention of Pollution by Oil, to include the Arctic region within the spatial scope of the ban. The reason for this is that the existing ban on HFO in Antarctic waters already exists in MARPOL Annex I and the working group, PPR 6, decided it was the most appropriate instrument for the ban on HFO in Arctic waters (IMO, 2019, February 21).

The International Code for Ships Operating in Polar Waters (Polar Code) is prescribed and mandatory under both the International Convention for the Safety of Life at Sea (SOLAS) and the International Convention for the Prevention of Pollution from Ships (MARPOL). Entering into force in January 2017, the Polar Code covers the full range of design, construction, equipment, operational, training, search and rescue requirement and environmental protection matters relevant to ships operating in the waters surrounding the two poles (IMO, 2015). The Polar Code has several operational and structural requirements for ships operating in the Arctic. Under structural requirements there is measure 1.2.1 that requires all category A and B ships with fuel tanks up to 600 m^3 to be built with a double hull to prevent fuel holding cells from being close to the outer shell (IMO, 2015). Under operational requirement 1.1.1 In Arctic waters any discharge into the sea of oil or oily mixtures from any ship shall be prohibited. The Polar Code emission regulations are mandatory for ships operating in the Antarctic, whereas it is recommended that ships follow the same guidelines (Chircop, 2016). In order for the Polar Code to be effective for limiting impacts of ships in the Polar North, Part II on Environmental Protection may have to be revisited and redrawn to incorporate more stringent measures on emission control.

2.5.1 Canadian Governance for Arctic Shipping

Spanning more than 150,000 kilometres, Canada has the world's longest coastline (Pew, 2016) and the majority of it is located in the northern latitude, within the Arctic Circle. Canada relies heavily on shipping for trade both nationally and internationally. Communities in remote Arctic regions rely on regular resupply of products and services via "sealift" as roads and rail are insufficient methods of transportation (Council of Canadian Academies, 2017). The unique ecosystems and cultural lifestyles of the people who live in the north are dependent on shipping but also wary of the impacts increased presence will have in the region (Dawson et al. 2016).

The Arctic Waters Pollution Prevention Act (AWPPA) is a federal statute that prevents the pollution of Arctic waters within and adjacent to the mainland, islands, and archipelagos of the Canadian Arctic (TC, 2019). The Act regulates on issues regarding deposit of wastes, enforcement, and shipping safety control zones, among others. The Arctic Shipping Safety and Pollution Prevention Regulations (2017), Arctic Waters Pollution Prevention Regulations (2010), Navigation Safety Regulations (2005) among others fall under this act.

Oil spill response protocols are in place for the Canadian Arctic, however critics argue these response set-ups are outdated and insufficient for the type of harsh environment (AMSA, 2009, and Dawson et al. 2016). The Arctic Shipping Pollution Prevention Regulations (ASPPR), which aims to prevent any pollution risks in Canadian waters north of latitude 60°N through a governance regime (TC, 2010), has been in place since the 2010. In January 2018 a reform of Canadian Arctic shipping legislation occurred that replaced the ASPPR with the "Arctic Shipping Safety and Pollution Prevention Regulations" (ASSPPR) (Bartenstein, 2019). The major difference between these two policy iterations is that the ASSPPR of 2018 matches more closely the international Polar Code amendments that came into force in January 2017. The ASSPPR covers ship construction requirements, ice navigation issues and planning, fuel and water concerns, and sewage and oil deposit mishaps, as is unavoidable in health and safety scenarios or ship damage from collision or stranding (Canada Gazette, 2017). The ASSPPR incorporates certain sections of the SOLAS and MARPOL conventions on shipping safety and pollution prevention, but mostly applies it to "Canadian vessels navigating in polar waters and to foreign vessels navigating in a SSCZ of the Canadian Arctic" (Bartenstein, 2019). The Polar Code's requirements on oil pollution prevention have basically been integrated into Canadian law through duplication into the ASSPPR, with operational and structural design requirements, such as double hull standards and minimum distances between tanks and hulls (Bartenstein, 2019).

Canada is currently working on establishing low-impact shipping corridors, which are intended to mitigate and control negative impacts on the ecological and social environment of the North (Bartenstein 2019). In 2016 the Pew Charitable Trust called for an integration of the Northern Marine Transportation Corridors Initiative (NMTCI) into a shipping corridor framework to strengthen the risk management and protection of environmental features and indigenous communities rights (Pew, 2016). The combination of the integrated shipping corridors framework with the national low-impact shipping corridor plan could lead to a holistic management system that enhances vessel and human safety and empowers northern communities. In 2013 Canada became a signatory to the Arctic Council's "Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic" which focuses on pollution preparedness and response collaboration between Arctic states (Arctic Council, 2013).

Chapter 3. Methods

This chapter describes the methods used to evaluate the different views held by stakeholders on application of guiding principles in the risk management procedure, use of FSA in risk management at the IMO, and the ban of HFO in the Arctic. The aim of using these methods is to provide insight into the attitudes, beliefs, and motives of the stakeholders concerned with Arctic shipping issues, using the context of the proposed ban on HFO as an exploratory case study. In this chapter, subsection 3.1 describes the first step of research, the literature review, which was used to shape the scope and objectives of this study. Following that a series of semi-structured interviews were conducted with selected stakeholders. This was to gather information in order to make an assessment on views of how the ban on HFO was framed and which risk management processes were used to assess the issue and how this affected decision-making at different levels. Subsection 3.2 describes the participant selection and procedure taken for this second methodological step. Finally, a comparative analysis of the interview data was completed using NVivo, qualitative coding software. Descriptions of the data sources, the methodology used to conduct the stakeholder interviews, and the comparative analysis is included in subsection 3.3.

3.1. Literature Review

A literature review was conducted at the beginning of the research period in two-stages. The first stage focused on policy documents of the IMO, called IMODocs. These were reviewed for background information on the process of decision-making related to the proposed HFO ban. A review of all IMODocs on the HFO ban, black carbon impacts, and risk and impact assessment methodologies was conducted to observe which member states and observing organizations submitted proposals and documents to the IMO. These included proposals by member states and NGOs, rebuttal documents, final reports from the sub-committee on Pollution and Prevention Response working group, and final reports of the MEPC meetings. Documents from MEPC meetings 69 to 74 were examined for any relevant information on HFO or black carbon.

The second stage focused on peer-reviewed journal articles, white papers, and government documents on the topics of risk management and governance, Arctic shipping, and the IMO's risk proactive risk assessment methodology, the formal safety assessment (FSA). This was conducted in order to gather sufficient background knowledge and assess the literary landscape on these three main topics and form a critical analysis for this project.

3.2. Semi-structured Interviews

The second main component of this research was to attain data for a multi-stakeholder assessment on the governance process at IMO. This occurred by conducting a series of semi-structured interviews with different stakeholder groups, using the proposed ban on HFO as a case study to understand the decision-making process behind risk management and governance on marine environmental protection issues. Three stakeholder groups were chosen as the target focus groups: Arctic Council member states of the IMO, non-governmental organizations (NGOs), and industry members. Interviews were to be conducted in two semi-formal rounds of interviews with target participants. The first was to focus on International level participants at the IMO during the MEPC 74th meeting and the State delegates that were relevant to the study scope. This included, but was not limited to, member states of the Arctic Council: Canada, Finland, Russian Federation, USA, Denmark, Sweden, Norway, and Iceland. The second round of interviews regarded national and regional stakeholders and was to occur in Canada. The target participants included federal departments, regional departments, non-governmental organizations, and industry stakeholders. In actuality, the two-tiered interview process did not occur as intended, mostly due to stakeholder schedule constraints and reality of time frame, however 11 interviews were carried out between May and September 2019.

3.2.1. Participants

Stakeholders chosen for the study were identified as being part of three pertinent groups in shipping risk management issues. Shipping industry members, NGOs, and IMO/Arctic Council member states were chosen due to their involvement and influence on the proposed HFO ban. Indigenous groups, although recognized for their involvement in the issue and maintaining stakeholder status, were not included in this project due to time and resource constraints.

Arctic Council member states were targeted because they are the states that are in, bordering, or nearby the Arctic Circle boundary as prescribed by the IMO. They are the states that will endure most consequence if an HFO spill occurs. Member states such as Canada, U.S.A., the Russian Federation, Norway, Finland, Denmark (Greenland), Iceland, and Sweden were approached during the MEPC 74th meeting at the IMO in London, UK, in May 2019. Only three of the eight Arctic Council member states responded to the request of being interviewed. One IMO member state, but not Arctic Council member, agreed to the interview. The non-Arctic Council member state continues to follow and contribute to the work done at IMO on the HFO ban in the Arctic due to their interest in the issue.

Industry was the second target group. The shipping industry is a major stakeholder in the IMO process. Many international shipping associations have consultative status at MEPC and MSC meetings and subcommittee meetings, such as PPR6. Industry stakeholders were identified as having a large stake in the project as governance decisions could directly affect their socio-economic operations and environmental standards. Five industry members agreed to the semi-structured interviews. Two were international associations, two were Canadian operators in the Arctic, and one was a Canadian association.

Non-governmental organizations were the third target group, of which only two agreed to the interview. NGOs hold consultative status at the IMO and can attend meetings, similarly to industry members. Table 1 displays the number of each target group interviewed for the study.

Stakeholder Groups	Number of Participants
Arctic Council member states	4
Industry	5
NGOs	2
Total	**11**

Table 1. Number of participants in each target group.

3.2.2. Procedure

As part of the research study involved observing the 74th MEPC meeting at the IMO, the first step in the procedure was to contact the Arctic Council member states. Delegates received a project brief handout at the initial encounter and then were emailed an invitation to take part in the semi-structured interview to discuss the process behind regulating and developing the ban on HFO. The request for interviews began in May but because of busy schedules of delegates, only two interviews occurred in last week at IMO, late May 2019. Follow-up emails were sent to interviewees to lock down interviews in June through to August. Prior to any contact with interviewees, an ethics approval was conducted according to the Marine Affairs Program internal requirements and consent forms were sent to all participants in the follow-up emails. All interviews lasted between 45 minutes to just over an hour and occurred over phone or Skype due to the researcher's location.

Interviews were conducted in a semi-structured style; participants were given a questionnaire that contained Likert scale questions and open-ended questions that allowed for expansion on topics. The questionnaire was structured into three sections: 1) questions on risk management guiding principles, 2) questions on the Formal Safety Assessment guidelines, and 3) questions focusing on the case study of the proposed HFO ban. The ISO 31000 Guidelines framework was used to structure the questionnaire. The three main sections related to the three main components of the guidelines and several questions were composed to relate to each section. Figure 6 shows the ISO 31000 guidelines and how it relates to each section of the questionnaire. To view the questionnaire, see Appendix C.

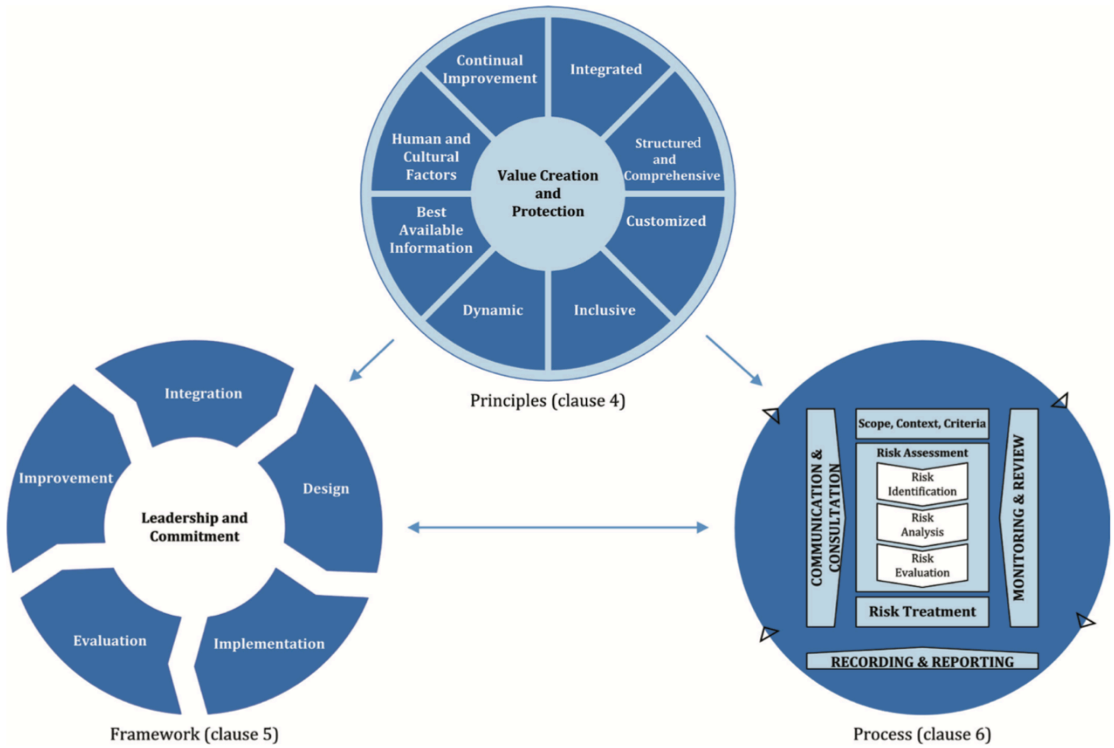

Figure 7. ISO 31000 Guidelines standard framework (ISO, 2018).

3.3. Comparative Analysis

Audio recordings of each interview were transcribed and then imported into NVivo for coding. Coding was conducted for the comparative analysis on the three main topics of this research: 1) the ranking of guiding principles for two scenarios (actual and ideal) of application within IMO risk management processes; 2) the use of FSA for the ban on HFO; and 3) risk categorization of use and carriage of HFO in the Arctic.

For the first phase, only seven out of the total 11 interviewees agreed to rank the guiding principles. Out of that seven, only five (n=5) went through the table and explicitly ranked each principle. The ranking of the principles used a Likert scale table where each participant could select a value for each principle ranging from 1-5, 1 as “always” and 5 as “never”. This was done for two different scenarios in which the stakeholders were asked how they viewed the principles being applied in actuality at the IMO and how they would like to view them as applied ideally. Some participants ranked principles on two values, which were then divided into two .5 values to equal a total value of 1. For example: If one participant ranked *Dynamic* as “sometimes” and “rarely” the value is split, so .5 falls under each value ranking to equal one whole. This occurred for six of the eight principles because one participating stakeholder out of the total five (n=5) was unable to choose decisively the ranking of those principles. In order to achieve an even 5 on the x-axis, the .5 values had to be used.

For the second and third phases, the comparative analysis used NVivo to identify phrases and statements made by each participant on the topic. For the use of FSA in risk management at IMO, statements in response to questions on the FSA (see Appendix C) process were coded. Two prominent themes appeared which are discussed in Chapter 4. A similar process was used for the pre-assessment framing of HFO as a risk; participants were asked to choose a risk type classification according to IRGC risk escalator, seen in figure 2. In conclusion, the purpose of these methods was to identify guiding principles in need of more attention in the IMO risk management process, reasoning behind the use or lack of use of the FSA for this issue, and challenges in framing the risk of HFO for risk management purposes.

Chapter 4. Results

This chapter presents the results of this study. The results from stakeholder input on the governing principles are presented first. Secondly, interpretations on the use of the FSA for the proposed ban on HFO are described, and lastly the results of risk framing of the issue and how stakeholders understand it are portrayed. In the last subsection, 4.3.1, results on what stakeholders thought other risk control measures are discussed.

4.1. Guiding Principles at IMO

As discussed earlier in this report, the importance of having guiding principles in the risk management process is for value protection and achieving informed decisions. To assess the application of the ISO 31000 Guiding Principles in the risk management processes at the IMO in relation to marine environmental protection issues, participants were asked to rate each principle on a Likert scale. The Likert scale presented a range from which stakeholders could choose the degree of application of each principle.

The two scenarios of principles in actual application and principles in ideal application were presented to the stakeholders to assess. The first scenario was intended to measure the application of the guiding principles in actuality at the IMO. This analysis of the principles highlights knowledge gaps on how they should be applied to risk management within the IMO. The second scenario was intended to measure the desired application of each principle by stakeholders in risk management at IMO and highlights future development needs on improving risk management procedures.

Only seven participants out of the total 11 answered the questions about the application of guiding principles at the IMO. The four outliers stated to certain degrees unfamiliarity with the principles and process of application or uncertainty with their level of expertise in relation to guiding principles in risk management. A few of the seven stakeholders who participated in the ranking also stated similar opinions but agreed to participate notwithstanding their experience with IMO risk management processes. Only five out of the seven stakeholders went through the tables and ranked each principle directly. The two stakeholders that did not complete the tables spoke briefly and in general to each principle. The resulting answers on the two scenarios came from this breakdown of participants: three Industry members and four IMO member states. The following two subsections describe the results for the first phase of this research.

4.1.1. Actuality Scenario

While several of the principles ranked as applied "very often", "sometimes" and "rarely", no participant chose either end of the Likert scale, "always" or "never", for any of them. Most of the principles fell in the "very often" and "sometimes" categories. Participants ranked *Integrated, Dynamic, and Cultural Factors* the lowest. The principles of *Continual Improvement* and *Structured and Comprehensive* were ranked medium. The principles of *Inclusion, Customized, and Best Available Information* ranked the highest. Table 2 shows the breakdown of how each principle in the first scenario was ranked from highest to lowest.

Highest Ranking ("Very Often")	**Lowest Ranking** ("Sometimes"/"Rarely")
	Integrated (4.5/.5) **5**
	Dynamic (1/4) **5**
Customized (3/2) **5**	
	Continual Imp. (2/2) **4***
	Structured and Comp. (2/2) **4***
Best Available Data/Info (1.5/2.5) **4**	
Inclusive (2.5/1) **3.5**	
	Cultural Factors (1/2) **3**

Table 2. Ranking of principles in Actuality scenario. Ranking of principles based on their value weight scores. The bolded numbers are the total value scored per principle. *The principles *Structured and Comprehensive* and *Continual Improvement* fell evenly on both ranks because they had an even score of 2 for "very often" and "sometimes/rarely" hence they are classified as neutral principles.

The principles under Highest Ranking scored more values under "very often" and "sometimes" with no or only .5 "rarely". This led to the weight being larger on the "very often" value score, ranking them higher. The principles under Lowest Ranking scored more values under "sometimes" and "rarely", with limited scores of "very often". The number in bold is the total amount of stakeholders who ranked the principles. The principles of *Structured and Comprehensive* and *Continual Improvement* are the two that fall evenly on both ranks because they had an even score of 2 for "very often" and "sometimes/rarely" hence they are classified as neutral principles. Figure 7 presents the results in entirety for the Actuality scenario.

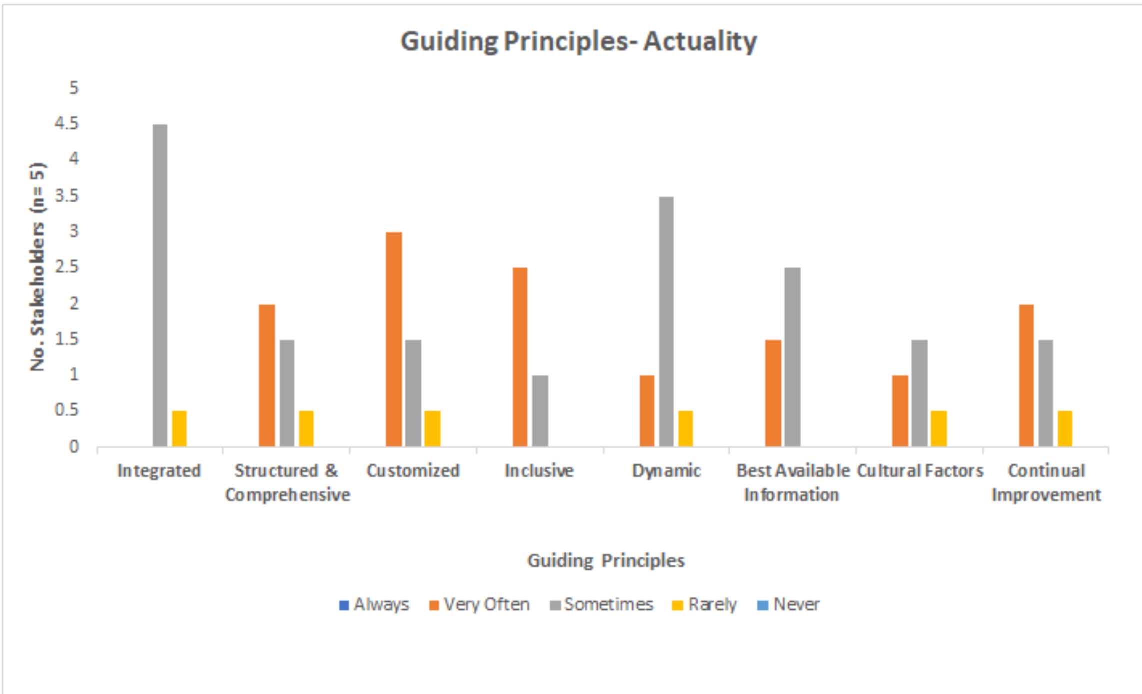

Figure 8. Responses from participants on the first scenario of the application of guiding principles in actuality.

<u>Integrated</u>

The principle of *Integration* has the lowest ranking among the eight guiding principles. Participants ranked it predominantly as "sometimes" and one participant split it between "sometimes" and "rarely". Reasons vary for this with one participant; Member State #1, stating it is not obvious whether risk management is integrated into the whole of the organization. They state that a more transparent and systematic way of integrating risk management throughout the IMO would be helpful for participants to clearly realize it is a part of the process.

A different participant, Industry #1, stated that there is still resistance to the concept of the FSA in the larger shipping industry sector for reasons of preferring "simple prescriptive rule making" to comply with over performing an integrated risk assessment. The direct quote below describes their view on the principle:

> "I think the result is that the FSA is seen as a bolt on, rather than being integrated in the risk management process. It's something that is added on as an extra that shows that we've met the requirements to do an FSA without [being] fully embedded into the process…It's something that we have to do but at the same time it's what a lot of stakeholders don't like very much. FSA is like any other process; whether it works or not is entirely dependent on how it's applied. I mean the best idea in the world isn't going to work very well if it isn't properly applied. And I do worry that sometimes the FSA is not applied as well as it could be."
>
> – Industry #1

The same participant also spoke about generational differences among participating members of IMO having an influence on the *Integration* principle. They stated the following on different aspects that may be influencing the application of the principle:

> "I think it's a question of maturity, as we move along it becomes more imbedded and I think if you look at the safety aspect of risk management, (integration) is becoming more accepted than with the environmental side, at least the value of it. So I think ultimately with this one it's just a question of the organization evolving and maturing. In some ways it comes down to people. I don't want to generalize here but in my experience younger people tend to be much more open minded than older people, so once you've had a transition from one generation I think you'll see a significant improvement in integration." – Industry #1

Other participants in the study noted the nature of IMO as being a political organization results in slow operation and compromises on applying the principle of *Integration* in risk management processes. Industry #3 stated:

> "Does it lead to a result of integrated, structured and comprehensive, continual improvement? In my opinion, sometimes very rarely because it takes time because the animal is so slow and made up of compromises."

<u>Dynamic</u>

The second poorly rated guiding principle in the survey was the *Dynamic* principle. Four stakeholders rated it as "sometimes" and "rarely", and one as "very often". Participants noted the slowness and consensus-based nature of the IMO to affect the dynamism of the organization in dealing with newly emerged or changed risks, either within or external to the risk management process. Paraphrased from Member State #2: the process at IMO takes a long time and there are a lot of countries that have to come to an agreement on the item so that's less opportunity for being very dynamic.

One Industry participant noted that the different work streams of the organization operate at different paces and incorporate positive feedback processes to improve any limitations or deficiencies in workflow and results. Their opinion was that the maritime safety division was operating more proficiently than the marine environmental protection work stream. The stakeholder stated that the focus on safety issues such as life saving appliances, stability, and ship construction in the MSC division lends to a more focused approach than with environmental protection issues, such as greenhouse gas emissions, because of the differences in uncertainty of the risk problems. The MEPC division of the IMO struggles with applying the dynamic principle in their risk management because of the structure of the organization and political aspects:

> "I think it's an indication of the political dynamic. If you look at safety, say the goal-based standards for bulk carriers, there's unanimity that we shouldn't have bulk carriers breaking apart and sinking…If you look at some of the environmental topics, because they're quite politically divisive, you don't have that common base point or that common understanding and I think you can see that does make quite a big difference." – Industry #1

Cultural Factors

The third lowest rated principle was *Cultural Factors.* Only three participants rated this principle however, so the results could be different if the two other participants rated it. It ranked higher as a "sometimes" and "rarely" degree than "very often", so it is classified as a low ranked principle. Some participants confused the concept of this principle, some following the ISO 31000 definition more so than describing it as the integration of different cultural knowledge for the issue of the proposed HFO ban (i.e. indigenous knowledge). Participants noted it as being more of an "unspoken principle", where people are aware of the influence from human behavior and cultural nuances, but no measures are in place to note the effect. One Member State participant stated that human behavior and cultural influences might not be as easily taken into account or dealt with so they might get a secondary rating among other issues regarding risk management.

Paraphrased from the interview:

> The organization may not be unwilling to deal with them; it might just be a more difficult area because it's not like scientific data that you're dealing with and human behavior and cultural aspects are more difficult to take into account. It's difficult to find a solution for that, but we certainly should be aware of the influence cultural factors and human behaviors have on risk management at IMO.
>
> – Member State #1

The same participant proposed that facilitating a dialogue between different stakeholders could be an option that could potentially lead to more innovative solutions on managing human behavior and cultural factors. Industry #1 stated an important aspect of the *Cultural Factors* principle: that different stakeholders select information and data that supports a particular outcome in FSA processes, based on cultural composition. Again this is particularly sensitive to the type of risk problem being addressed. A quote from the participant describes the differences:

> "…If you look at the safety side of things there are some differences there but overall the differences are quite minor. But if you look at the, HFO in the Arctic, depending on the positions of the different stakeholders, the data and analysis that feeds into the FSA can be completely different because basically stakeholders are selecting the information and data that supports a particular outcome. And I think unfortunately that's just the nature of a political organization." – Industry #1

The same participant noted that cultural differences between developed and developing countries influence risk management approaches. They stated that North American and European countries are more comfortable with the concept of a goal-based standards or analytical approach whereas developing countries lean more towards wanting prescriptive rule-based approaches, due to their maturing economic development. In addition to this, the context of cultural differences leads to differing sensitivities to risk problems, which will influence outputs of risk assessments. An example given by Member State #2 is the value one country places on economic growth versus protection of the environment will likely affect how a risk assessment is applied and results achieved.

Continual Improvement & Structured and Comprehensive

The principles of *Continual Improvement* and *Structured and Comprehensive* were ranked a total of four times, with one participant withholding their ranking of the principles. The principle of *Continual Improvement* was noted to be challenging according to Member State #1 primarily because, when participating in IMO risk management processes, they acquire new information on the issue at hand after decision-making has concluded. Applying the new information, both about the issue and to the risk management process directly to improve it, is difficult in the IMO setting. Paraphrased from Member State #1: a challenge is when to use the new data or learning experience to re-evaluate and go through the risk management process again.

Structured and Comprehensive was not a problem principle, with few participants discussing it. Only one participant, Member State #2, stated that political intentions of IMO participants might potentially affect this principle, which could potentially change the outcome of a risk management process. This response was vague and not elaborated on however.

Best Available Data and Information

The incorporation of historic and current data and future projections and expectations was viewed as being moderately applied via the *Best Available Data and Information* principle by four participants. The principle was ranked high, with participants classifying it as "very often" and "sometimes" being applied in actuality at IMO, but there are caveats with the principle. In relation to marine environmental protection issues, Member State #1 stated quandaries around when to use expert judgment to make conclusions and inform decision making when lacking scientific data or to know when enough data has been accumulated on the topic. Industry #1 states that with the FSA process:

> "The FSA processes are very sensitive to the input data…if people have a predetermined idea of what the final answer should be it's actually pretty simple to manipulate the input data. And again that's when it can get quite difficult and quite divisive at times." – Industry #1

Principles Overall

While only five participants rated the ISO Guiding principles on the Likert scale, the remaining two spoke more generally about them. The IMO does not officially follow the ISO guiding principle standards and one participant stated that it would be helpful if the organization was reminded from "time to time" that they are there and provide guidance for risk management procedures. However, a different participant noted that the organization has no collective agreement that the principles be upheld; rather it is up to individual countries and participating organizations to apply their principles to their positions and decision-making on risk management issues:

> "At the end of the day whenever there's a decision to be made, decided on by the majority, it's what the majority decides. So as far as upholding the principles, those are decided by individual countries on whether or not or how they support the position they take up on an issue. At IMO there's no collective agreement that those principles have been upheld, but rather the decisions and positions of the countries are based on their particular view and their principles that they apply."
>
> \- Member State #3

To conclude, the principles of *Integrated, Dynamic, and Cultural Factors* ranked the lowest and participants noted issues with each. Although the other five principles ranked higher, participants highlighted concerns about each and provided some recommendations on how they could be applied in a more consistent and effective manner, discussed in Chapter 5.

4.1.2. Ideal Scenario

For the scenario of ideal application of the guiding principles in risk management at the IMO, most participants in the survey chose "always" and "very often" for each guiding principle. Six participants rated the principles for this scenario instead of five, thus giving the total number of value six. The sixth participant only ranked three principles (*Customized, Inclusive, and Cultural Factors*). The principles of *Customized, Cultural Factors, Inclusive, and Dynamic* were ranked a .5 or 1 value in the "sometimes" value between two different participants (both member states). Figure 8 shows the degree to how each principle was ranked and the break down for each value. Reasons for the principles that were ranked in the "sometimes" category are described below.

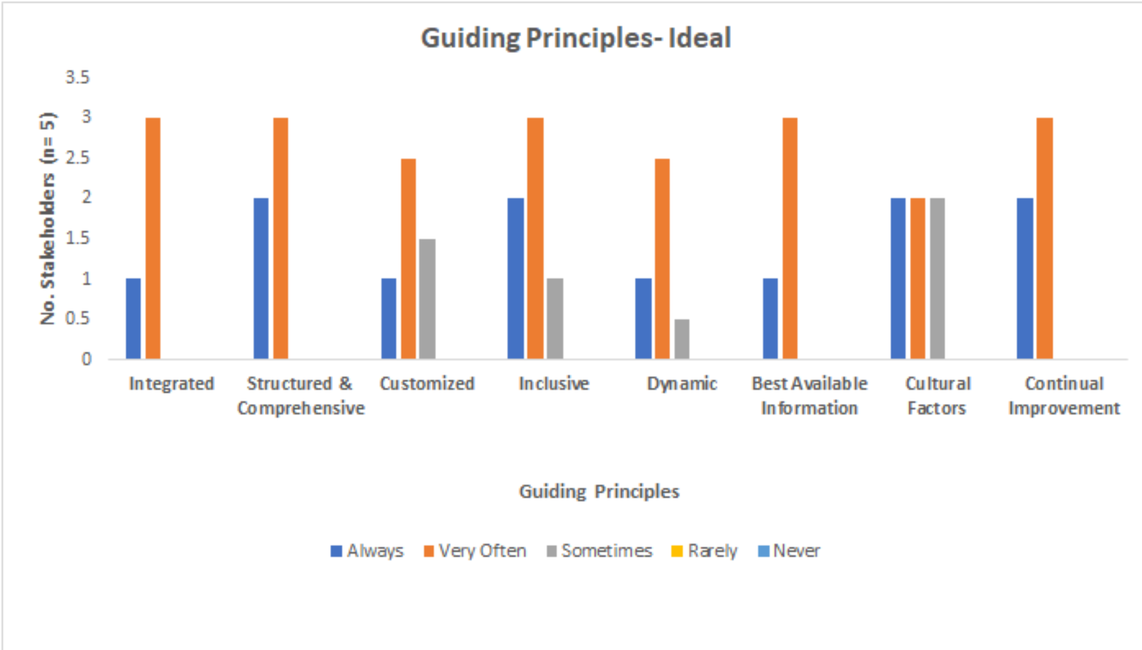

Figure 9. Responses from participants on the second scenario of application of guiding principles ideally.

Customized

Member State #2 discussed the *Customized* principle in more detail than any other participant. Using the HFO ban as an example, they mentioned that customization of risk management would depend on the context and type of the risk problem at hand. In their view, they stated the customization of the assessment methodology as a way of delaying the process by different countries. This can take away time and energy from addressing the problem and executing workflow efficiently. Their statement below explains their thoughts on this issue:

> Whether it should be customized depends on the subject. For example, in the case of the HFO ban, customization of the process takes a lot of time and discussion while establishing the ban could have progressed. Felt like sometimes countries used it to delay the process, which was a pity. It's not always positive to make it very much extended and customized if it's maybe not really necessary.
>
> – Member State #2, paraphrased

Inclusive

Similarly to *Customized* principle, Member State #2 viewed the *Inclusive* principle as potentially having a negative attribute of delaying the process by including countries that may not prioritize the issue in the same manner as other countries or view the risk problem as a hindrance to economic development. On the other hand, Industry #2 stated there are "people who have no skin in the game" financially, but whose votes might influence Canada's socio-economic situation as a response to pushing an agenda item forward, such as the HFO ban. Several other participants of this study mentioned this as being an issue in the case of the HFO ban, which will be discussed in Chapter 5 of this report. On the positive side, five participants ranked the *Inclusive* principle as being applied "always" (n=2) and "very often" (n=3), agreeing that the inclusion of outside participants related to the risk problem, such as indigenous communities who may not have as big of a voice at the IMO, to ensure holistic management and inclusion of different sets of knowledge.

Dynamic

Member State #2 discussed the Dynamic principle as being ideally applied between "very often" and "sometimes", the difference coming down to the context of the risk problem. Paraphrased from the interview: Due to the size and operational model of the IMO, it would not be feasible to be dynamic all the time. Rapid change and reactions to the risk management process could become confusing for participants and could negatively impact the process and decision-making.

Cultural Factors

Most participants put this principle under "always" and "very often" as an objective to ensure stakeholder biases were being kept track of. Member State #2 ranked it as "sometimes" because of the impact from cultural biases and human behavior. Their reasoning was that the cultural factor might subjectify decision-making at the high level.

Principles Overall

Although most participants selected "always" and "very often" for most of the guiding principles for the ideal scenario, they all mentioned that this is dependent on the risk problem being managed. Unsurprisingly, context is critical in evaluating which principles are key for application, and many participants mentioned they should be applied in varying degrees on a case-to-case basis. Participant Industry #3 stated that across the board *Structured and Comprehensive, Inclusive, and Continual Improvement* principles should always be applied for risk management. They stated they do not see these three principles being applied in actuality at IMO. Member State #3 stated that indeed all principles should be applied in a consistent manner but was unsure how that would be achieved: "How that would be done, I find it almost impossible under the multilateral setting."

4.2. Use of FSA for HFO ban

The second main component to this research was to identify the use of the FSA for assessing the proposed ban on HFO in the Arctic. Results from interviewing stakeholders revealed that the FSA was not used in the HFO ban occurred for two reasons: 1) the IMO chair did not deem it necessary during initial plenary discussions and the decision was made to implement a ban based on information submitted from member states and organizations; and 2) stakeholders view it as a long, expensive, and subjective method for conducting risk assessments. The following quotes regard the first reason:

> "When the decision was taken to look at the mitigation of risks of HFO in the Arctic, the decision was already made on needing to address the risks." – NGO #1

Member State #4 spoke about how the process for deciding on the ban transpired at IMO. In their view the issue of HFO in the Arctic was not brought up until MEPC 70 in 2016 when NGOs highlighted the concern about the risk of a spill. Member states developed proposals for the agenda for MEPC 71 in 2017. They stated Canada was one of the proponents that supported finding mitigation measures for risks associated with HFO in the Arctic. From MEPC 71 onwards the risk was framed as a spill risk instead of an emissions risk, which was the original case when it was brought up before MEPC 70, according to Industry #5.

Member State #3 stated that there was an acknowledgment at IMO to consider the impacts a ban would have when the decision was made to form the ban. The impact assessment would help clarify what policy options would work best in regards to any caveats of the ban:

> "I think doing the impact assessment and getting the information that would come from that would then lead IMO in how to implement the ban. If there's any kind of exclusions, exemptions, timing, all the different factors, that should be considered when doing it." – Member State #3

Industry #2 stated that completing an FSA on the issue could have been helpful in officially determining the risks, suggesting no other options other than a ban as a mitigation measure:

> "What they should have done is shown that no matter what mitigation measures you've put in…the likelihood of this [spill] happening is too high to ignore and so the ultimate step of ban is the only way to go. I can say that the notion of doing a

> formal safety assessment is another basic and fundamental requirement before you start to change the world. But without seeing how that would have been done …it's hard to say that you'd be happy with the outcome." – Industry #2

The following quotes regard the second reason, particularly on input data:

> "The problem in the environmental side particularly is people tend to start with a predetermined idea of what the outcome should be. And because they do that that tends to heavily influence the FSA process. For example banning HFO in the Arctic, if the predetermined position is to support the ban then the chances are you would prepare and demonstrate it's a necessary measure. Conversely if you didn't want it, the FSA prepared would probably show the opposite. And that comes down to the fact that the process of this nature is very sensitive to the input data and by manipulating the input data you kind of skew the process in a certain direction." – Industry #1

Some stakeholders viewed the FSA as a useful process for risk management but unclear as to when to use it. For the case of the HFO ban, two participants, both Member States #1 and #2, agreed it would be a beneficial and comprehensive tool for assessing the risk problem. Member State #2 noted that the methodology determined by PPR6 for the impact assessment was very similar to the FSA framework. The steps taken in the FSA are similar to those steps taken in the impact assessment methodology and Member State #2 stated they didn't feel the need for a whole meeting to establish what ended up being the same methodology for the impact assessment on the HFO ban. The differences and similarities of the two methodologies are discussed in Chapter 5 and Table 5 shows the comparison of the two methodologies.

Industry stakeholder #4 stated they felt an FSA for the proposed HFO ban would have benefitted risk management as offering guidance for the process "in order to help appropriately steer decision-making by the organization." Industry #2 stated more transparency on the risk assessment process would have been better:

> "The risk assessment should've been done in a more transparent way. In one that really reflects what the likelihood is of a spill. For example, I haven't seen any statistical analysis of any incidents that may have occurred that has led them to, that has validated in any way, their predisposition towards the ban." – Industry #2

Member State #3 stated that the FSA process relies on quantitative data, which may impede results:

> "The FSA is quite involved and I think it's fairly expensive to conduct. I think it tries to rely on more quantitative data and to a large extent I'm not sure how much that [the quantitative data] really is available. Quite frankly the FSA has been used at IMO a number of times with varying degrees of success." – Member State #3

4.3. Risk Framing of HFO

The third main component of the study was to ask stakeholders how they viewed the risk of HFO use and carriage in the Arctic. This was to assess how they framed the risk. The IRGC (2009) risk escalator was used to structure the survey. It defines the amount of processes necessary for each risk category. Simple risks require routine operations by agency staff. Complex risks require risk assessments and input from external experts and uncertain risks require that in addition to input from directly affected stakeholders and requires risk balancing. Finally, ambiguous risks are the larger, convoluted risks that require input from all actors, from agency staff to stakeholders to public consultation and analysis of risk trade-offs. Frames are ways of communicating certain values to the stakeholders involved and societies at large. IMO frames the risk of HFO as risk of a spill and risk to the ecological and social region (IMO, Feb 21, 2019). In asking participants how they view the risk of HFO in the Arctic, there were differences between stakeholders in environmental and economic perspectives.

All participants placed HFO on the risk spectrum. There were two stakeholders who were unsure of where to place them, so the total result is thirteen instead of eleven. The two participants that had trouble choosing a category in relation to how the risk was perceived were Member State #2 and Industry #3. When discussing the categorization of risk some broke it up between socio-economic risks and ecological and cultural risks and ultimately chose a category that suited the issue best. Table 3 shows the overall results of the categorization of HFO as risk, whereas Table 4 displays the breakdown of which category each participant chose.

Simple Risk:	Complex Risk:	Uncertain Risk:	Ambiguous Risk:
1	4-5	5	1-2

Table 3. Results from asking participants how they view the risk of HFO in the Arctic. Each stakeholder was asked to select the risk problem category they respectively thought aligned with their view of the risk. There were two stakeholders who were unsure of where to place them, so that's why there are thirteen instead of 11 total.

The breakdown of risk categorization by participants is as follows:

	Simple	Complex	Uncertain	Ambiguous
Member State	#2	#1, #2	#3, #4	
Industry		#3, #4, #2	#1, #5	#3
NGO			#2	#1

Table 4. Breakdown of stakeholder placement in risk categorization of HFO in Arctic. Member State #2 and Industry #3 were unsure of placement and chose two categories respectively.

Simple

For this category there was only one participant, Member State #2, that classified the risk of HFO as simple. The primary reason for this was their understanding of the risk problem of a spill of HFO being clear with a straightforward description of the risk problem and increased probability correlated with increased shipping rates. Paraphrased from the interview: historical data of shipping patterns shows an increasing, which increases the risk of a spill. Where they deviate from the categorization of it being a simple risk problem is in risk control options and solutions for addressing it; effects of the ban complicate the risk control option.

Complex

Member State #2 chose the complex category to satisfy the second half of the quandary of where the risk of HFO in the Arctic and implementation of the ban fell on the IRGC (2009) risk spectrum. They inferred that because of the nature of the Arctic being a multi-user region plays into what solutions and mitigation measures can be implemented, making it more of a complex risk problem.

Industry #2 classified HFO in the Arctic as complex, stating consequences are high and the risk probability being low. Member State #1 classified it as complex risk due to the environmental and cultural implications of a spill in the region and needing more holistic approaches to addressing the problem in comparison to simple risk routine operations. Industry #4 also classified it as a complex risk, due to their view of the lack of scientific data used for the assessment. Industry #3 had the same issue as Member State #2 in being able to choose one category for the risk. Industry #3 chose between complex and ambiguous; complex for the reason of requiring scientific risk assessments and probability analyses based on actual versus future traffic patterns.

Industry #4 made the point of how the risk is different on the temporal scale. They stated that due to the current operational standards of ships in the Arctic it is rare to have a spill due to the safety standards in place. They stated, as an operating company, that none of their ships would navigate through the region unless it is highly certain there will be no consequence.

> "Our whole way of working is to get a ship from A to B safely and if we can't get to B, we don't get to B and that happens consistently in polar waters…When it does happen it's an aberration. Those kinds of incidents prompted the Polar Code…those ships that might have gone into Polar Waters in the past can't do it now because they have to prove they're capable of going into polar waters."
>
> – Industry #4

<u>Uncertain</u>

Four participants chose the uncertain category for the HFO risk. Member State #4 stated that due to the nature of the ban in the Canadian Arctic, where hundreds of people live and work in the region, socio-economic impacts will have to be assessed as much as the ecological impacts. In terms of the ecological impacts, Member State #3 stated the difficulty with assessing them is due to a lack of quantitative data on the impacts of HFO in the region. Regardless of the lack of data, they prefer the precautionary approach, mentioning that although it is currently "unquantifiable", the risk should still be prevented or mitigated.

NGO #2 described their reasoning behind classifying it as an uncertain risk due to the need of assessments by both external experts and affected stakeholders, while also requiring balancing of the risk in terms of economics.

> "One of the issues we'd have to consider is a lot of the people…are completely reliant on maritime transport for basically everything they need for their economies to function and these people are unfortunately already paying a massive premium because it's so expensive to maintain the shipping services to these isolated communities. I think there probably does need to be some sort of balancing of the economic costs and the economic lines to these communities and with the marine pollution risk." – NGO #2

The last participant to classify the risk under uncertain was Industry #5. They stated that the impact of a spill would require a scientific risk analysis, obtainable in the complex category, but mitigation measures deduced from risk balancing would fall under the uncertain category.

Ambiguous

Industry #3 classified the risk of a spill in complex and ambiguous. Reasons for the complex category are above; their reasoning for the ambiguous category is due to the multi-stakeholder involvement of the risk problem. Due to the multi-use region, they state a trade-off analysis is needed to assess the risk for the different communities and users of the Arctic. "There are communities being supplied in the Arctic…It's about trade-off and a better scientific assessment in my opinion," Industry #3.

The other two participants to categorize the risk as ambiguous were NGO #1 and NGO #2. NGO #1 stated they view the two main risks of carrying and using HFO in the Arctic as being the risk of a spill and risks associated with BC emissions. They stated:

> "Black carbon emissions happen all the time; the spill risk happens hopefully infrequently. So if you do have a spill you're going to then need to engage with all the different stakeholders and have people dealing in terms of safety of the vessels, crew, and passengers who are at risk, spill response side of things. I'm assuming that makes it ambiguous." – NGO #1

NGO #2 noted that the probability of a bunker spill is low in the Canadian Arctic and the assessment is based off of current ship traffic volumes. They recognize that current ship traffic, with experienced captains, decreases the risk of a spill. A concern of theirs is with the increased shipping projections and potentially having more inexperienced captains navigating through Arctic waters. The consequences of having more inexperienced captains increases the probability of an HFO spill, which would have high consequences on the marine environment and local communities due to the nature of the substance.

> "As traffic increases and more inexperienced captains start venturing into the Arctic, whether that's for tourism or the volumes associated with the Baffinland mine, there will be a lot more ship traffic. The probabilities also change: there's more chance of this spill, but the real issue here is consequence and because bunker fuel is thick and viscous, it emulsifies and is persistent in the marine

environment…there's a huge consequence to the marine ecosystem as well as to subsistence hunting and food gathering for communities. So on the consequence side it's very severe. On the probability side it’s low.” – NGO #2

Risk Framing Overall

A review of the risk framing results shows that member states predominantly categorize the risk of an HFO spill in the Arctic as complex and uncertain. They stated the risk problem would need involvement from a variety of stakeholders, from agency staff to external experts to directly affected stakeholders, such as shipping industry members and indigenous communities. A series of comprehensive risk assessments to obtain different risk control options and risk-benefit analyses to assess economic impacts were deemed necessary. Industry participants mostly chose complex and uncertain as well, with one choosing both complex and ambiguous due to the nature of the effect on multiple stakeholders in the region. Industry members requested more scientific data to incorporate into the decision-making on mitigation measures and stated that an HFO ban was not the best way to mitigate the risk. Lastly, NGOs predominantly categorized the risk as uncertain and ambiguous. This was due to the multi-resource and multi-user attributes of the region, acknowledging the various communities and economic developments operating in the Arctic. They recognized that probability of a spill was low according to assessments, however the consequences would be very high given the socio-ecological dynamic of the region. Risk trade-off analysis and a wide scope of stakeholder consultation and participation are necessary for addressing the risk.

4.3.1 Risk Control Measures for HFO

While the risk framing of HFO in the Arctic was explored with participants to determine how they view the risk, the section also included questions on what stakeholders viewed as potential risk control options (RCOs) in addition to the ban. Interview questions are in Appendix C of this report. Study participants offered insight into various RCOs, including existing legislative instruments, such as MARPOL regulations on ship construction and design requirements and the AWPPA and ASSPPR in Canada. NGO #2 and Industry #3 stressed the importance of implementing routing measures and ship traffic management measures as necessary methods of reducing the risk of an HFO spill.

> “Banning HFO is not going to eliminate all of the risks (probability)…Therefore if banning is done because it's felt that we don't have the structure in place to mitigate

> the risks, then it's still not going to address the other risks in the Arctic. To me it's putting in place proper traffic management in the Arctic, it's putting in place proper ice breaking resources, it's putting in place a true AIS and virtual aid system…Just saying banning HFO is needed because we cannot manage the traffic and therefore we don't want to have any risk of a spill, will still not have eliminated the other risks, so looking at it from an HFO ban in isolation but justifying it by the lack of inability to put some indication in place is a false logic in my opinion."
>
> – Industry #3

Many participants seemed confused about the parameters of the ban not including HFO as cargo and how that would decrease the likelihood of a spill in the Arctic. Participants understood the difference in spatial scope in regards to this, how the Russian Arctic varies from the Canadian Arctic and use of HFO as a terrestrial-based fuel source, but when considering the circumpolar Arctic, participants did not view the ban as being as effective if it were to include the carriage of HFO as cargo.

One other element that was explored in the research was the idea of implementing an Emission Control Area (ECA) in the Arctic. While some participants had no position on this notion, some stated that if there were sufficient data and scientific evidence on the benefits of creating one, they would support it. Member state #4 stated that it could potentially be a policy option to strengthen the protection of the Arctic from GHG emissions and climate forcing particulates, such as black carbon. However if an Arctic ECA were proposed then an assessment under the ECA submittal guidelines would have to be conducted and would most likely take the HFO discussion back into emission risk framing territory.

Chapter 5. Discussion and Recommendations

Risk governance for the Arctic region faces a daunting future in the coming century. Already wrought with social and environmental complexities, coming transformations brought on by the changing climate and a growing population will intensify the region's vulnerability. This will place a demand on all levels of governance, from the local and regional to national and international jurisdictions. The most prominent alteration is the shifting and diminishment of yearlong sea ice caused by anthropogenic climate warming. The lack of multi-year ice in transit ways has allowed for an increase in ships of all sizes to travel through for various reasons

(AMSA 2009, Pizzolato et al. 2013, and Lasserre, 2011). Tankers, general cargo vessels, fishing boats, and cruise ships are among many types of ships that pass through or sail to and from the Arctic. With the projected increase of Arctic shipping, risk governance will be needed to assess, communicate, and manage the risks associated with the increased shipping activity (van Leeuwen, 2015 and Ritsema et al. 2015).

The literature review provided background information on the governance frameworks in place for Arctic shipping, the Formal Safety Assessment, and the proposed HFO ban and provided a basis for the interview questions. The semi-structured interviews and qualitative coding provided a tool for assessing stakeholder views on various elements high-level risk management. This section discusses the final results on the three main components of the study: the ISO guiding principles, the risk management process of IMO including the FSA instrument, and the framing of the risk problem of HFO in the Arctic. The limitations of this study are discussed secondly. Finally, recommendations for risk management and governance of marine environmental issues are presented followed by recommendations for further research.

5.1. Discussion of Results

5.1.1. Implications for Management – Application of Principles

According to the evaluation of guiding principles by different stakeholders, not all principles are being applied as effectively as possible at the IMO in the risk management process. This is important to note because it shows which principles are valued higher and this affects risk management operations. The ISO 31000 Guidelines (2018) states risk management requires a balanced approach to applying all principles because they are foundational for managing risk. The IRGC Risk Governance Framework (2009 and 2017) states "good" governance relies on the applications of the principles, which will increase public trust and improve the overall management of risk problems in a comprehensive and holistic manner.

The following principles mentioned present challenges in risk management of Arctic marine issues at IMO because they are not as applied as other principles. The principle of *Integration* is one of importance, maintaining that risk management is an integral component of all organizational activities, however it ranked lowest among all eight ISO principles. Having this principle applied inconsistently throughout the risk management at IMO is considered highly problematic. It points to discrepancies in risk management tools, such as the FSA, in the different work streams of the organization. This has major implications for overall risk governance of marine safety and environmental protection issues.

One participant did mention that with coming generational shifts in member state attendees, the *Integration* principle might see more consistent application at the IMO. Having an ensuing generation that is more concerned with maintaining global ecological and cultural integrity through governing shipping activities may influence the level at which *Integration* is applied in risk management processes. In addition to this, the view of FSA as a "bolt on" process to meet standards may shift with the maturing of the organization and generational change. In regards to the shipping industry, there may be generational changes that shift the view of performing an FSA as a burdening and long-winded process to being necessary and more comprehensive than simple prescriptive rule making implemented by the IMO.

The political and structural nature of the IMO inhibits other principles to be applied in full, such as the *Dynamic* principle. Simply having so many moving parts, members, and work streams slows down the process of risk management and hinders the reflex of promptly addressing newly emerged or changed risk problems. In regards to the marine environmental protection work stream of the IMO, participants viewed it as being less dynamic than the marine safety division. The main reason for this was because of the political influences of member states on environmental risk issues. For example, the IMO has been trying to secure regulating measures for reducing GHG emissions in the short-, medium-, and long-term. It has taken them several years to come to an agreement on these measures because of the democratic format that IMO prescribes to. The same progress would not be taken on marine safety issues, because all member states value human lives and safety of seafarers relatively similar. By having different countries and organizations placing value judgments on human factors and environmental factors of a risk problem differently, the issue of having different opinions slowing down the implementation of marine environmental protection regulations arises. In the case of HFO, one can clearly see this occurring when looking at the timeline of implementing the ban. Is there really any way we can get IMO to be devoid of political biases? No, but there may be a way of getting it to work faster by implementing standardized principles at the beginning of working on an agenda item to streamline the process and give balanced weight to both work streams.

The third principle that has implications for risk management is *Cultural Factors*. This principle was ranked third lowest and was viewed more as an "unspoken principle". The influence from human behaviour and culture was noted by the participating stakeholders but is viewed as a difficult principle to measure. Differences in culture and human behaviour implicitly affect the input data that is used in risk assessments, which ultimately affects the risk evaluation and risk control options. If the IMO incorporated a framework into the risk management process to acknowledge the potential implications these factors have on risk problem solutions, then perhaps there would be a way to ensure limited cultural biases and human behaviour influencing the output of the assessment. One method of doing this could be by establishing a unanimous understanding at the outset on how the pre-assessment of the risk problem is conducted and what the result is, providing a baseline from which to move the risk management process forward.

The *Continual Improvement* principle is a challenge for some stakeholders. One participant mentioned that when dealing with the risk management of one issue, it is difficult to be constantly aware of new information coming in on the risk problem and applying that to the process. Capacity building within the organization or faculties of member states that are dealing with risk management would be one way of reducing the deficit in this principle (Aven and Renn, 2018). The way IMO functions can cause time constraints for some member states to feel they are applying the principles in full. With the HFO ban for example, one member state noted they felt pressure to conduct the impact assessment on time to submit to the IMO but because of this there wasn't capacity within the team to ensure consciously that each ISO principle was addressed and applied to the work. Increasing resources, such as adding more policy workers to a team and increased funding, could be one example for increasing capacity of member states to effectively work on risk management but also ensure the application of the guiding principles to the process.

Views on whether the IMO should formally agree on the guiding principles used for the whole organization or whether individual states decide for themselves which principles should be integrated differed in the results. One participant stated that the IMO should remind member states and organizations of the ISO guiding principles and encourage the application of them in the risk management process. This is an interesting idea: by having a reminder at the beginning of each working session on a shipping risk issue to incorporate and follow the guiding principles of ISO could ensure some degree of application in the risk management process. It would not necessarily mean having participating nations change their inherent values to match a standardized prescription of guiding principles, but rather ensure that each member state and organization applies at the very least the principles to the risk management process. Essentially, this notion enquires the IMO to make room within the working streams for member states to acknowledge the value judgement placed on risk and risk management and to consciously apply these to the work conducted throughout the process.

This potential method of ensuring the guiding principles are applied to the risk management process could have an impact on reducing gaps in knowledge or misunderstandings on evidence between participating members. The importance of reducing knowledge gaps is critical for reducing complexities and uncertainties about the risk problem at hand (IRGC, 2009b). This could potentially lead to a reduction of risk governance deficits (Aven, 2011). In addition to this, there is the potential for member states to discover new or different principles that would benefit the IMO risk management process.

5.1.2. Use of FSA in IMO Risk Management

The FSA is a risk management methodology where most focus is on hazard identification, risk analysis, and risk evaluation strategies, emphasizing the risk assessment phase of the risk management process. It is available to be used for assessing risk problems of marine safety issues or marine environmental protection issues. Results signify some operational issues of the FSA in general and the confusion on the lack of FSA use for the proposed HFO ban in the Arctic.

Although results were limited on the use of FSA at IMO in general, as many participants had little to no experience with the methodology, some highlighted general issues with using FSA for marine environmental protection issues. Several participants noted that the process of FSA is costly and extensive, leading to operational issues for some member states (Hermanski, and Daley, 2010). The reliance on quantitative data, as mentioned by one participant, dictates the quality of data used for the FSA; if addressing marine environmental issues with limited or incomplete quantitative data then the FSA would not be very well performed and accurate for risk management. Another participant noted that with many environmental risk issues, member states often bias the risk management process with political agendas. This suggests a predetermined idea of outcomes, which would influence the input data, swaying the results. Busby and Hughes (2006) mention that previous studies have offered risk assessments as solutions to dealing with politically hidden agendas on certain risk issues. However, having multiple participants of this study inform on the political aspects of the IMO, this solution has not yet been effective in exposing political schemes.

In regards to whether the FSA would have been useful for the HFO ban, some agreed it would have been, primarily because they saw similarities compared to the impact assessment (IA) methodology. Table 5 shows the five steps of both methodologies. The two methodologies are not identical; FSA focuses on risk assessment and decision-making recommendations whereas the IA methodology focuses on the policy options for implementing the ban as effectively and fairly as possible. However, it was stated that the methodologies were similar enough that creating the IA methodology was a duplication effort. This signifies a potential issue with the Customization principle in that depending on the risk problem, it may be unnecessary to allot time and resources to creating new assessment methodologies when applicable tools already exist.

FSA		IA	
Step 1	Hazard Identification	**Step 1**	Scope Definition
Step 2	Risk Analysis	**Step 2**	Policy Object Definition
Step 3	Risk Control Options	**Step 3**	Policy Options
Step 4	Cost-Benefit Assessment	**Step 4**	Impact Analysis
Step 5	Recommendations for Decision-Making	**Step 5**	Recommendations for Policy Options

Table 5. Comparison of steps in the Formal Safety Assessment methodology to the Impact Assessment methodology devised by IMO working group PPR6 (IMO, 2018a and IMO, 2019).

If using the IRGC governance framework (Figure 1) as a template, the FSA could generally be seen as Phase 1 (the of assessment and generation of knowledge), while the IA could generally be seen as Phase 2 (the management, implementation of decisions, and evaluation). What the FSA could potentially have helped with in the case of the HFO ban would have been to recommend other risk control options and decision-making recommendations for mitigating the risk of an HFO spill in the Arctic, in addition to the proposed ban. These risk control options were discussed in the interviews, with participants stating a ban alone will not completely rid the risk of an HFO spill, due to the condition of the ban not including HFO as cargo. Other risk control options mentioned were: creating an ECA in the Arctic (this would reduce use and burning of high-sulphur fuels such as HFO in the region), implementing better navigation aids such as vessel traffic management systems (Psaraftis, 2008), implementing better spill response regimes (this would help deal with impact/consequence of a spill, not likelihood/probability), and enhancing training regimes for captains navigating in polar waters.

5.1.3. Risk Framing

Regarding the pre-assessment phase of the HFO ban, some stakeholders had trouble choosing a category in relation to how the risk was framed. Some broke it up between economic risks and other as environmental and cultural risks. Participants viewed the risk of HFO in the Arctic as Simple, acknowledging the consequence of a spill from historical data and regarding the impact as high, thus needing a simple prescriptive regulation to decrease the likelihood. When considering the socio-economic, ecological, and cultural factors of the risk problem however, some viewed it as more complex, needing input from a wide range of stakeholders, including agency staff to affected groups. The uncertainty of how a spill would affect the indigenous populations, their livelihoods, health, and economic wellbeing, was said to be required in a risk assessment, if one were to be conducted. Due to these discrepancies in how the risk was framed by the IMO, participants had trouble categorizing the risk in one of the IRGC's risk escalator boxes. This shows that having an inconsistent frame can lead to improper risk management and confusion about who should be involved in the management process.

Potentially the way risks are defined in the IMO influences what is focused on during the procedures. Having a clear, unanimous definition of what risk is in the IMO context could potentially help clarify from the outset how to define the risk. This could help the rest of the process be transparent and in how member states move forward with recommended decision-making options. Using the HFO as a case study to assess how risks are framed at the IMO posed a challenge, as many stakeholders were aware of the predetermined outcome of the ban. If a different Arctic marine issue, such as shipping noise or lack of port infrastructure for ships, the results could have been more straightforward than with the HFO ban.

5.2. Limitations of this study

This section demonstrates the limitations of this research. Firstly, this research is exploratory and preliminary. The topic of risk governance and heavy fuel oil were deduced from previous practices and the literature review. This study may not consider enough the stakeholders related to maritime shipping activities, as only three major stakeholders were identified in this study. There are likely many stakeholders that could be included in a larger study who have been involved in and are impacted by the risk management and overall governance of IMO. These stakeholders can be confirmed with the further development of related research and consultation with existing stakeholders. A key stakeholder that should be constantly involved and increasingly heard on the issues of Arctic shipping risks is the Arctic indigenous community. As they are the people actively living and working in the circumpolar Arctic and experience the effects of climate change and increased shipping traffic, their input on how risks are managed and mitigated is crucial for the improvement of maritime governance.

Secondly, the results could vary with a selection of different interviewees from each stakeholder group; people with different or more related experience with the FSA for example, could have led to more robust results on that segment of research. The same could potentially occur for the section on the guiding principles. As only five stakeholders specifically ranked each principle using the Likert scale, results are limited and could vary from what was collected if more participants had been familiar with the principles in application of IMO.

Thirdly, limitations of the methodology include the interview questionnaire and lack of follow-up interviews for clarification. Most participants understood and were able to answer the questionnaire, however some feedback from some participants indicated that the questions were too technical and inaccessible. While attempts were made to help clarify the questionnaire for participants during interviews they did not stray too far from the original questionnaire as to keep consistency in results. This most likely means some questions were interpreted incorrectly affecting the results. In addition to this, interview transcripts were not sent back to interviewees for clarification. This could have helped expand on certain convoluted or unclear responses. Lessons learned from this suggest incorporating time in the study for clarification on interview transcripts to improve results.

Lastly, the nature of the proposed ban on HFO as fuel and carriage by ships in the Arctic, which was the case study for this research, most likely affected the results from stakeholders on the risk management process at IMO. In particular, the IMO 2020 sulphur fuel limit of 0.5 percent emissions outside of ECAs will affect the use of HFO by ships not only in the Arctic but also worldwide. This new regulation, coming into effect January 2020, will indirectly reduce the amount of HFO fuels by ships, reducing the likelihood of an HFO spill in the Arctic because ships will not be allowed to burn higher sulphur fuels (DNVGL, 2019). This regulation most likely had an effect on the results about risk control options, such as designating the Arctic as an ECA to prevent the use of HFO. A second aspect of the HFO case that must be considered in affecting the participant responses was the seemingly predetermined outcome of the IMO secretariat to implement a ban on HFO in the Arctic, regardless of whether an FSA was conducted or not. If a different case study had been chosen to focus on in regards to the risk management process and IMO risk governance, perhaps results would have varied significantly from stakeholders.

Although this study has some limitations, it achieved its purpose of assessing stakeholder views on the use of guiding principles in risk management at IMO, the usefulness of FSA in the context of the proposed HFO ban, and the differences in the pre-assessment and risk framing of the case study. By using the HFO ban as an example of deficits in risk governance on Arctic marine environmental protection issues, this study can offer insight for future studies on similar stakeholder assessments and framework evaluations.

5.3. Recommendations

5.3.1 Recommendations for Risk Management and Governance

Arctic governance will be challenged in coming decades due to increased interest and presence from other countries in the region for natural resource exploration, shipping transportation, and destinational travel. International and national governance frameworks will need to proactively deal with the uncertainties and complexities of these events that will undoubtedly emerge. In order to do so, some recommendations are made on the three sections of this research below:

First, in order to avoid accumulating risk governance deficits in addressing marine environmental protection issues, the application of the ISO guiding principles, or a variation thereof, is recommended to be incorporated at an initial risk management stage at the IMO. This will enable a uniform approach for all member states and organizations to actively follow and apply the underlying principles to the risk management process. In addition to this, increased transparency on how and when to apply the principles in the risk management process would benefit stakeholders.

Second, the use of FSA for marine environmental protection issues, particularly in the Arctic, is recommended be made clearer by the IMO in order for member states to know when to use it for associated risk problems. Having a clearer description for the application of FSA in marine environmental protection issues, so stakeholders do not view it as a hindrance or burden, could potentially increase the use of the methodology in related risk problems. Clarifying what can be achieved by conducting an FSA in this field could be beneficial to stakeholders and increase usage, which would help the overall risk management process.

Third, an initial discussion among members on the problem framing of a newly emerged risk could be prompted at the beginning of intersessional working groups. Use of IRGC's risk categorization escalator for example, could be used to clarify the categorization of the risk problem and show which management options and what level of stakeholder input are needed. Having this stage at the beginning of the risk management process could streamline progress and avoid confusion among participants. In addition to this, an agreement on what "risk" is defined as could help the process from the onset.

And lastly, in the case of the HFO ban, which turned out to be a predetermined policy option decided on by the IMO during MEPC 72, it is recommended the ban include the carriage of HFO as cargo to increase the effect of limiting impacts of a spill of HFO in the entire circumpolar Arctic. Since the IMO 2020 sulphur limit is coming into effect as of January next year, this regulation will inadvertently decrease the usage of HFO as fuel in the Arctic. By including HFO as cargo, the consequence of a spill in the Russian Arctic would be significantly reduced.

5.3.2 Recommendations for Further Research

This study can be adapted for a similar project with a wider or narrower scope. It can be used for specific arctic regions, specific levels of governance, and other arctic issues. It can be expanded to include more stakeholders, such as various Arctic indigenous communities and shipping sectors, or narrowed down to look just at high-level intergovernmental governance schemes. More widely, risk governance deficits of IMO decision-making could be explored and applied to a similar study and provide recommendations on how to avoid them and implement effective Arctic governance. It is recommended that if this work were to carry on into another project, Indigenous communities be included in the study scope and objectives.

It was intended that participants answer more in-depth questions about the Formal Safety Assessment and how it is used in the context of marine environmental pollution issues at the IMO. Questions about the validity and usefulness of the FSA were to be analyzed and coded for a series of normative values (Busby, 2006) to derive results. Due to the inconsistency in the participants' experience using FSA, questions pertaining to the FSA function, guidelines, and process were inconsistently answered and insufficient data was collected on this section. Due to this no recommendation can be made on how to improve the FSA and use of FSA in marine environmental pollution issues. The main recommendation made in this context is to revisit this section of the study and carry out a separate research project that targets participants experienced in FSA to gain more substantial data in this field.

The research shows that we need more transparency and forthcoming communication in how the principles are being followed to ensure risks to the Arctic are being governed in a conscious way. This will help ensure Arctic shipping is being managed in a proactive manner to help mitigate and adapt to coming changes.

Chapter 6. Conclusions

With the increasing heterogeneity in activities in the Arctic region and projected increase in ship traffic, risk management is required to continuously address emerging and changing risks. Risk governance will need to adapt to increase interconnectedness between all stakeholders, actors, governing bodies and institutions in order to ensure the sustainable use and protection of the diverse and unique attributes of the North.

This study acts as a starting point for risk managers and decision makers to understand how and to what extent the guiding principles are applied in the risk management process at IMO in regards to marine environmental protection issues. There is a clear distinction between how participants of IMO view the application of principles in maritime safety issues, which seems to be much clearer and straightforward, in contrast to the environmental division. This report can be used as a jumping off point for further research on the guiding principles. The research methodology could be expanded to include more stakeholders or constrained to a more narrow scope of the Arctic region.

Member states and organizations need to address the disjointed application of the guiding principles in IMO risk management to improve the overall risk governance of Arctic shipping issues. This could be applied to a larger scale and go as far as applying it to all ocean governance for the coming decades. The world faces multitudes of risk problems, whether perceived or real, from factors such as climate change, global population increase, and natural resource depletion. It will take a deeper comprehension that values and principles affect the way we frame risk problems and prescribe risk management tools to inform mitigation measures to advance ocean governance from a static, precautionary framework to a consciously proactive system that benefits all aspects of life via risk management into the next era.

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8. Appendices

Appendix A. Impact Assessment Methodology

Draft Methodology submitted by the PPR6 working group in February 2019 (IMO, 2019).

ANNEX 2

DRAFT METHDOLOGY TO ANALYSE IMPACTS OF A BAN ON HEAVY FUEL OIL USE AND CARRIAGE AS FUEL BY SHIPS IN ARCTIC WATERS

Background

1 The overarching problem has been defined at MEPC as risk of possible fuel oil spills by ships that use and carry heavy fuel oil (HFO) for use as fuel in Arctic waters. MEPC 71 recognized that the release of oil into Arctic waters remains a significant threat from ships to the Arctic marine environment. Future ship traffic in Arctic waters is projected to rise, thus increasing the likelihood of HFO spills and associated impacts on Arctic environments, indigenous and local communities, industries and economies. Spill response in the Arctic can be hindered by harsh weather conditions. Due to low temperature of Arctic waters the degrading process of HFO is very slow. HFO is more persistent than other fuels when spilled, and as such poses a unique hazard to the Arctic environment, impacting a broader range of marine life, and is thus more challenging to clean up. At MEPC 72, measures to mitigate the risks of spills were proposed, including a ban on HFO used and carried as fuel by ships in Arctic waters.

Step 1: Defining the scope

2 Given discussions at MEPC, the Committee instructed PPR, on the basis of an impact assessment, to develop a ban on HFO for use and carriage as fuel by ships in Arctic waters, on an appropriate timescale. In order to develop such a measure, there is a need to analyse its impacts including, but not limited to, social, environmental and economic considerations. Therefore, the problem that prompted development of this methodology is the need to fully assess the effects on Arctic indigenous and local communities, industries, economies and coastal and marine ecosystems, both adverse and beneficial, of a potential ban of the use and carriage of HFO as fuel by ships in Arctic waters.

Step 2: Defining a policy objective

3 MEPC 71 agreed that the risk of an HFO spill in the Arctic warranted a new output, namely, the development of measures to reduce risks of use and carriage of HFO as fuel by ships in Arctic waters. There are two elements inherent to this policy objective that all viable policy options must meet. First, the policy option(s) must reduce the risk of an HFO spill from ships in Arctic waters. Second, due to the urgent need to protect fragile Arctic environments and in light of the likely increase in Arctic shipping, the policy option(s) must reduce risk in the near term. Therefore, policy options must be assessed not only for their impacts, but also for how well they meet policy objectives to solve the defined problem within an appropriate timescale.

Step 3: Policy options

4 The scope of work stated in document MEPC 72/17 (paragraph 11.9) contains the policy options that MEPC has approved for work at the PPR Sub-Committee.

5 Impact assessments should consider the following identified policy options:

.1 to develop, on an appropriate timescale, a ban on the use and carriage of HFO as fuel based on document MEPC 72/11/1; or

.2 to develop, on an appropriate timescale, a ban on the use and carriage of HFO as fuel, with other factors incorporated.

Step 4: Analysis of impacts

6 Analysis of impacts of an HFO ban should be guided by but not limited to the impact assessment methodology presented in the annex to this document, based on MEPC 73/9/1, which represents a balanced approach to assessing both costs and benefits of an HFO ban to indigenous and local communities, industries, economies and the coastal and marine ecosystems of the Arctic.

Step 5: Comparison of policy options and recommendation of preferred option(s)

7 The PPR Sub-Committee has been directed to "on the basis of an assessment of the impacts, develop a ban on HFO for use and carriage as fuel by ships in Arctic waters, on an appropriate timescale" as stated in document MEPC 72/17 (paragraph 11.9.3). Policy options that were identified in step 3 of this combined methodology above would result in choosing one of the following options:

.1 to develop, on an appropriate timescale, a ban on the use and carriage of HFO as fuel based on document MEPC 72/11/1; or

.2 to develop, on an appropriate timescale, a ban on the use and carriage of HFO as fuel, with other factors incorporated (step 4 of the annex).

8 As stated in paragraph 3 above, the option that is chosen as preferred must reduce the risk of an HFO spill from ships in Arctic waters, and reduction of risk must occur in an appropriate timescale.

Appendix B. ISO Guiding Principles

Definition of the guiding principles as seen in the ISO 31000:2018 Risk Management Guidelines (ISO, 2018).

a) Integrated

Risk management is an integral part of all organizational activities.

b) **Structured and comprehensive**

A structured and comprehensive approach to risk management contributes to consistent and comparable results.

c) Customized

The risk management framework and process are customized and proportionate to the organization's external and internal context related to its objectives.

d) Inclusive

Appropriate and timely involvement of stakeholders enables their knowledge, views and perceptions to be considered. This results in improved awareness and informed risk management.

e) Dynamic

Risks can emerge, change or disappear as an organization's external and internal context changes. Risk management anticipates, detects, acknowledges and responds to those changes and events in an appropriate and timely manner.

f) Best available information

The inputs to risk management are based on historical and current information, as well as on future expectations. Risk management explicitly takes into account any limitations and uncertainties associated with such information and expectations. Information should be timely, clear and available to relevant stakeholders.

g) Human and cultural factors

Human behaviour and culture significantly influence all aspects of risk management at each level and stage.

h) Continual improvement

Risk management is continually improved through learning and experience.

Appendix C. Interview Questionnaire

The survey and semi-structured interview questions used in this study as pertinent to Chapter 4.

Section 1 – Survey used for asking participants on the application of principles in actuality and desired scenarios at the IMO.

1. The International Organization of Standardization (ISO) has guidelines for risk management. In your organizations view, to what extent does IMO risk management follow the ISO 31000 Guideline Principles? Please rank the following in the table below.
2. In your organizations view, to what extent do you think the risk management process at IMO ***should*** follow these principles?
3. Can we discuss the principles x, y, z in more details?
4. Can you describe any other challenges your organization experiences regarding how ***risk management*** is conducted at IMO, regarding the marine environmental protection issues?

Principle	*1- Always*	*2- Very Often*	*3- Sometimes*	*4- Rarely*	*5- Never*
Integrated					
Structured and Comprehensive					
Customized					
Inclusive					
Dynamic					
Best Available Info/data					
Cultural Factors					
Continual Improvement					

Section 2 – Questions on FSA

1. The FSA, as described by the IMO, is "*a rational and systematic process for assessing the risk related to maritime safety and the protection of the marine environment and for evaluating the costs and benefits of IMO's options for reducing these risks*".

   In terms of usefulness, how does your organization view FSA as a process to perform risk assessments at IMO?

2. As a stakeholder involved in maritime shipping that may have safety and/or environmental risks, is it procedurally clear when to use FSA for marine environmental protection issues? (*If answer no, go to 11.b.)*

   a. How is it procedurally unclear when to use FSA?

   b. How can the clarity on when to use FSA for marine environmental issues be improved?

3. What are some challenges or opportunities that occur in your organization when the FSA results are used for regulatory decision-making at the IMO?

4. At what level does your organization think the transparency of FSA risk assessments should be to inform regulatory decision-making on environmental protection measures at the IMO?

   ○1 Very High   ○ 2 High   ○ 3 Moderate   ○ 4 Slightly Low   ○ 5 Low

Section 3- Questions on Risk Framing

1. There are four main categories of risk described by the IRGC (2009). How does your organization classify the continuation of use and carriage of HFO in the Arctic as one of the four categories? Please select an option below.

Simple Risk: *Requires routine operation by agency staff.*	**Complex Risk:** *Requires scientific risk assessment by external experts*	**Uncertain Risk:** *Requires risk balancing and assessments by external experts and affected stakeholders.*	**Ambiguous Risk:** *Requires risk tradeoff analysis and deliberation from all parties involved, from agencies to general public.*

2. May you please explain your risk categorization on HFO?

3. Does your organization think the FSA is comprehensive enough for this issue?

   a. Why or why not would it be beneficial to have an FSA completed on the HFO ban in the Arctic?

   b. Why has your organization not submitted an FSA on the HFO ban in the Arctic?

   c. Will your organization submit an FSA on HFO in the Arctic?

4. What are the challenges with setting the scope for the HFO ban?

5. What would your organization recommend as RCOs/RCMs for the HFO ban?

6. How would your organization view FSA as a comprehensive process in assessing the cost-benefit of socioeconomic and environmental risks in the context of an HFO ban?

7. What level of responsibility does your organization feel is necessary that IMO achieves comprehensive FSA to inform decision making for the HFO ban in the Arctic?

○1 Very High ○ 2 High ○ 3 Moderate ○ 4 Slightly Low ○ 5 Low

8. What is your organizations position on whether the ban on HFO should include a ban on the carriage of HFO as bulk cargo in addition to the ban of use and carriage of HFO?

    a. What evidence is that position based on? (*e.g. environmental impact, development opportunities, accident risks, etc.*)

    b. Do you think your organization would update its position about this issue if an FSA was completed and results showed different conclusions on the HFO ban?