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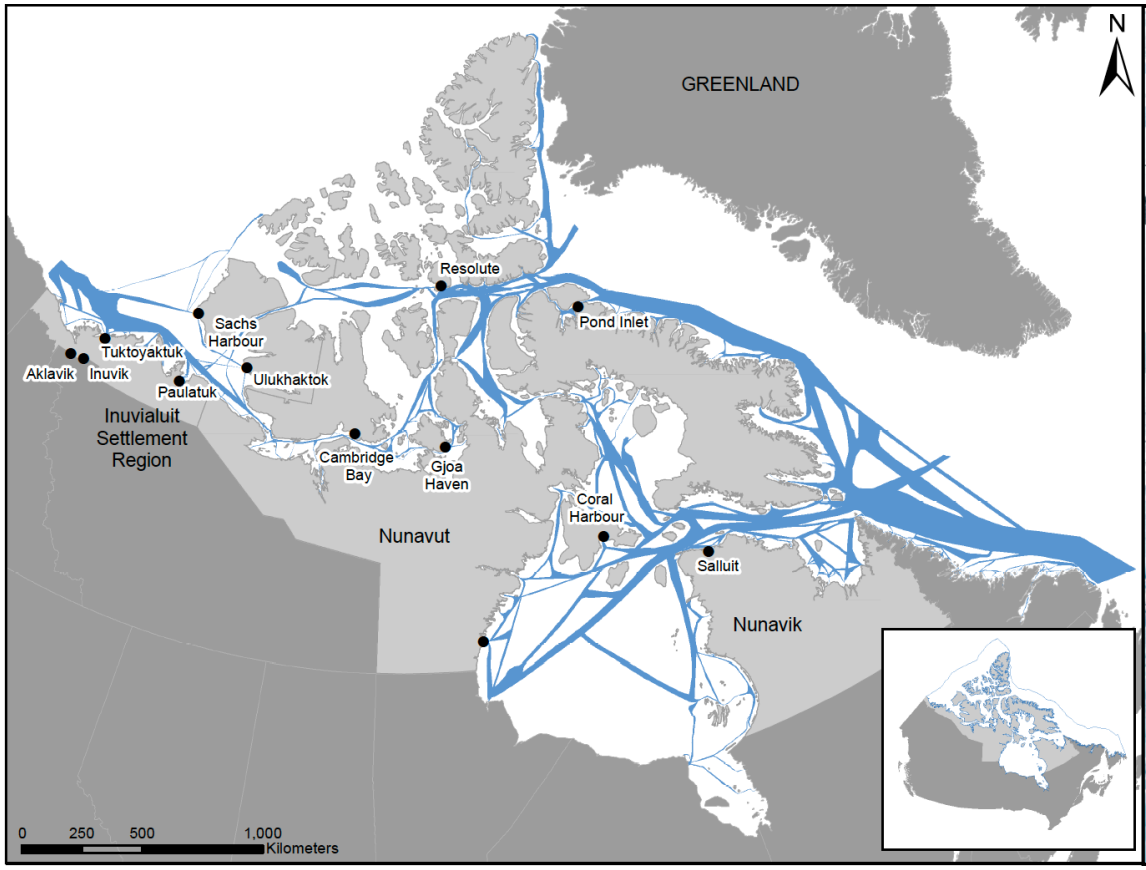
Opportunities and Strategies for Effective Management of Low Impact Arctic Shipping Corridors



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EXECUTIVE SUMMARY

Ship traffic has been increasing across the Canadian Arctic over the past decade and additional growth is expected as climate change continues to enhance navigability in the region. In response, the Government of Canada (GOC), including the Canadian Coast Guard, Transport Canada, and Canadian Hydrographic Service are developing a set of 'Low Impact Shipping Corridors' to support shipping governance. The objectives of the corridors are to; 1) establish incentivized and voluntary corridors; 2) provide marine navigation safety support; and 3) respect local cultures, ecology, and the environment. The GOC is currently engaging rights holders and stakeholders in an official capacity to promote discussions on the location and desired governance of low impact shipping corridors. The study presented here is separate from this official GOC activity and was designed as an independent research project that may aid GOC and other decision makers in the development and implementation of effective corridors governance. The specific purpose of this study was to identify and evaluate potential governance strategies that can aid in the effective management of Canada's growing Arctic marine vessel traffic through a Low Impact Shipping Corridors approach and to enhance understanding of the opportunities and challenges related to governing marine vessel traffic across Inuit Nunangat and Arctic Canada.

The research team undertook an iterative three-part survey (Policy Delphi) in which expert rights holders and stakeholders contributed their knowledge and perspectives on 1) strengths and weaknesses of the corridors framework; 2) potential management strategies that could aid in the effective governance of Canada's growing Arctic marine vessel traffic through a corridors approach; and 3) what type of governance body may best suit regional and local needs. Participants identified a range of strengths and weaknesses of the corridors initiative including, for example, the need for enhanced marine navigation and safety, minimization of ecological and cultural impacts, guiding effective infrastructure and service investments, and shared leadership and collaborative management. From the suite of strengths and weaknesses, participants identified a total of 45 corridors-management strategies that could potentially enhance related strengths and mitigate weaknesses that were revealed. The suite of potential management strategies was organized into relevant thematic areas, which included 1) Governance and Regulation, 2) Resources and Services, 3) Knowledge Mobilization and Communication, 4) Culture and Environment, and 5) Research and Monitoring. Each individually identified strategy was carefully evaluated using a structured rubric by a 31-member expert panel based on five factors including a) affordability, b) implementability, c) effectiveness, d) co-benefits, and e) timeframe for implementation. Affordability and implementability collectively can be considered measures of overall 'feasibility'. Levels of consensus among the expert panel members was considered, and where a significant divergence of opinion emerged it was taken into consideration when ranking priority management options (i.e., only strategies receiving high and/or medium levels of consensus among the expert panel members were listed as priority management strategies).

Results of the analysis revealed a total of ten management strategies ranking the highest including: establishing a 'one stop shop' public website for corridors-related information; establishing a single point of contact that Inuit Nunangat community members can connect with if they observe non-compliance of regulations; publicly sharing the names of vessels that violate corridors regulations; providing real-time digital maps of the corridors to all operators; modernizing navigation aids; investing in modern charting; establishing a network of digital communications infrastructure; creating educational material and providing fuel spill kit training for Inuit Nunangat communities; and sharing of key features in the corridors such as Culturally Significant Marine Areas (CSMA) and Ecologically and Biologically Significant Areas (EBSA) with ship operators for consideration when navigating in the area. When considering principles for effective corridors management, two overarching ideas emerged from the expert panel, including the idea that corridors management should be responsive, and inclusive, as well as dynamic.

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1.0 INTRODUCTION AND CONTEXT

1.1 BACKGROUND

Ship traffic has more than doubled in the Canadian Arctic over the past three decades and additional growth is expected considering climate change related decreases in sea ice and subsequent increases in maritime navigability (Dawson et al. 2018; Mudryk et al. 2021). In order to support safe and sustainable shipping, the Government of Canada, including the Canadian Coast Guard, Transport Canada, and the Canadian Hydrographic Service, have co-developed the 'Low-Impact Shipping Corridors' as part of the Ocean Protection Plan. Low-Impact Shipping Corridors (herein referred to as the 'corridors') are "…dynamic shipping routes throughout Canada's north where the necessary infrastructure, marine navigational support, and emergency response services be provided to ensure safer marine navigation, while respecting the sensitive northern environment and its ecological and cultural significance" (Levitt, 2019, 68). The corridors are designed as a dynamic framework of maritime routes that encourage voluntary use among ship operators through incentives including infrastructure, enhanced navigational information, emergency services, and other services. The official goals of the corridors include to: 1) enhance marine navigation safety, identify priority areas for service enhancement, provide the infrastructure, navigational support and emergency response services needed for safer marine navigation; 2) minimize potential effects of shipping on wildlife, respect the environment and local ecology, respect ecologically sensitive areas; 3) respect culturally sensitive areas and respect local cultures; 4) guide investments in the North and identify priority areas for investment; and 5) collaboratively develop a governance framework to support the corridors (Transport Canada 2017; Government of Canada 2021).

Over the past ten years the corridors have been used as a framework to focus many academic studies designed to understand shipping trends, shipping impacts and risks (Chénier et al. 2017; Dawson et al. 2018), navigation innovations (Beveridge 2018; Chénier et al. 2020) community concerns and recommendations (Carter et al. 2018; 2019; 2020; Dawson et al. 2020), cruise ship and general shipping governance (Reid and Dawson 2019; Dawson et al. 2021), law and policy (Porta et al. 2017; Wang 2017; Sheehan et al. 2021) and ship-source underwater noise impacts (Halliday et al. 2017; 2018). One of the major collaborative studies conducted on the corridors is the 'Arctic Corridors and Northern Voices' (ACNV) project led out of the University of Ottawa and in collaboration with multiple government agencies, Indigenous organizations and communities. The ACNV project team trained over 15 graduate students and 50

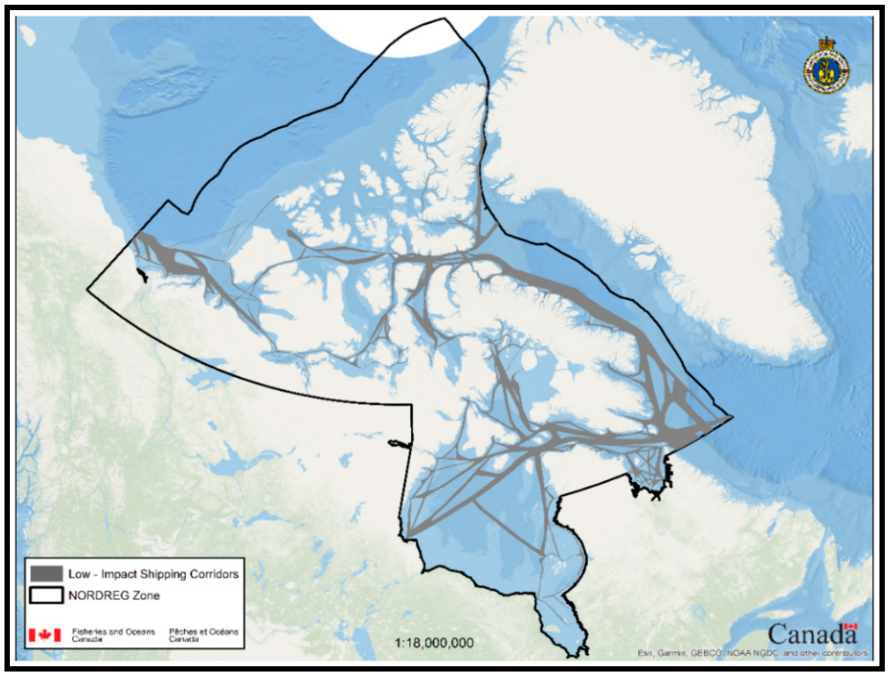


Figure 1 Low-Impact Shipping Corridors in the Northern Canada Vessel Traffic Services Zone (NORDREG Zone)
(Source: Chénier et al. 2020).

northern and Inuit youth while working with 14 communities in Arctic Canada to; 1) identify local concerns about increased shipping activity, 2) identify culturally significant marine areas, and 3) identify potential management strategies within the corridors and nearby local communities and community harvesting areas that could reduce the impacts of marine traffic. Dr. Jackie Dawson (project leader) and the ACNV team received the 2020 Social Sciences and Humanities Research Council Impact award in the Connections category and a 2021 Governor General's Innovation award for their efforts to support the development of new datasets, new understandings, and information that supports operational and policy decision-making in the region.

1.2 OBJECTIVES

One of the most consistent findings emerging from the ACNV project was the need to further identify and evaluate how the corridors framework could and/or should be managed collaboratively and in consideration of the multijurisdictional nature of the region. In this study, we directly respond to this need where the project's overarching **aim** was to identify and evaluate potential management options for corridors governance. The specific **objectives** of the study included to:

1. Identify the perceived strengths and weaknesses of the low-impact shipping corridors framework;
2. Identify potential management strategies for managing ships within a corridors framework;
3. Evaluate the identified management strategies based on perceived effectiveness, affordability, implementability, co-benefits, and timeframe for implementation; and
4. Inventory potential stakeholder and rights holder groups that could be part of a shared leadership approach to corridors governance.

1.3 DEFINING GOVERNANCE

The origin of the word 'governance' is a Greek nautical term meaning "to steer, to pilot" (Harper 2022). Governance is what makes it possible for organizations, communities, groups and nations to attain their goals. The Australian Indigenous Governance Institute (n.d.) explains: "It is useful to think of governance as being about how people:

1. choose to collectively organise themselves to manage their own affairs,
2. share power and responsibilities,
3. decide for themselves what kind of society they want for their future, and
4. implement those decisions."

How the corridors will be governed and the ways in which rights holders and stakeholders will be involved in ongoing corridors governance is still being decided upon by the Government of Canada. While decision makers and policy experts work towards concrete processes and frameworks for co-governance or shared leadership it is useful to engage in research and knowledge generating exercises, such as this one, in order to enhance the availability of scientifically rigorous evidence that can be used in policy deliberations.

The first step in governance planning is typically to identify what's working and what's not i.e., investigate strengths, weaknesses, opportunities, and risks. **The second step in governance planning** is to identify and strategically evaluate strategies based on a set of relevant criteria – in this case for example, feasibility (affordability and implementability), effectiveness, timeframe for implementation, and presence and/or level of co-benefits that may be generated by implementing a particular management strategy.

2.0 METHODS

2.1 IDEA GENERATING STRATEGY - POLICY DELPHI

To achieve the project objectives (Section 1.2), the ACNV team employed a Policy Delphi Methodology using an iterative three-part survey. A Policy Delphi is defined as a group-oriented Idea Generating Strategy (IGS) that aims to uncover consensus and/or disagreement on governance options or strategies for dealing with a particular challenge (i.e., in this case corridors governance) (see de Loë and Wojtanowski 2001; Linstone and Turoff 2002; Donohoe and Needham 2009; and see review in Lemieux and Scott, 2011). The approach provides a constructive forum and a structured method for an expert and diverse group of people to interact anonymously in order to elicit a wide range of responses on potential policies or management options (Needham and de Loë 1990; Lemieux and Scott, 2011). Furthermore, the approach provides a means for structuring a participatory process to address complex multi-scale and multi-stakeholder problems where views on potential solutions for a particular challenge(s) may differ (Linstone and Turoff 2002; Donohoe and Needham 2009). By design, participants are provided the freedom to outline and contest varying viewpoints, to think independently between survey iterations, and most importantly, to bring their unique experiences and deep understandings of the issues of concern without fear of repercussion or humiliation (Lemieux and Scott 2011). The idea is to make effective use of participants' diverse judgements, opinions, and expertise in order to identify and investigate the best possible governance and/or management strategies available for a particular challenge or area of focus (ibid).

In this study, we employed a well-established Delphi framework developed by the United Nations Environment Program (UNEP) (UNDP 2005; UNEP 2008) to evaluate corridors management strategies. The UNEP framework has previously been used to evaluate governance and management options for global challenges related to environmental change, parks and protected areas planning, and tourism development, among others (Lemieux et al. 2011; Dawson et al. 2015; Mukherjee et al. 2015; Dawson et al. 2017). The framework follows a focused process of engaging stakeholders (and rights holders), defining the specific challenge needing solutions, assessing the risks and opportunities of that situation, identifying adaptation or management options, and lastly, fully assessing each of the proposed options (Figure 2). This study focuses on the final two components of the framework which involved identifying and evaluating adaptation and/or management options for low-impact shipping corridors governance. Problem identification and evaluation of risks and opportunities of shipping activities was previously completed during an earlier part of the Arctic Corridors and Northern Voices (ACNV) project (Figure 2). (For additional results and publications related to the ACNV project see www.arcticcorridors.ca).

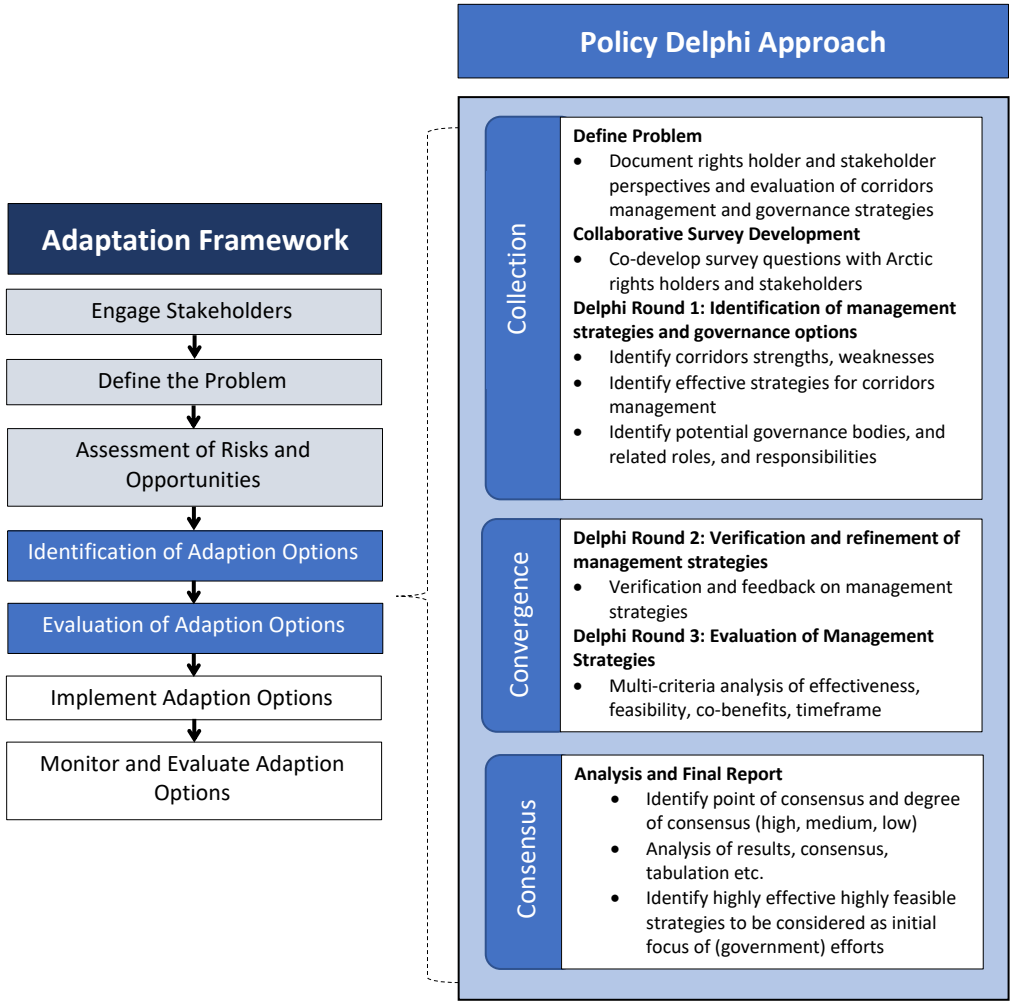


Figure 2 Adaptation framework and Policy Delphi approach
(Adapted from UNDP 2005; UNEP 2008; Donohoe and Needham 2009; Dawson et al. 2017).

2.2 THREE-PHASED ITERATIVE POLICY DELPHI APPROACH

The Policy Delphi approach used within the framework involved a three-phase approach focused on: 1) collection, 2) convergence, and 3) consensus. During the **collection phase** a survey (round one) was developed and reviewed by 23 external experts who were affiliated with federal, territorial, and regional governments; Inuit organizations; Institutions of Public Government; shipping and cruise ship industry; universities; as well as non-government organizations. Working with these external experts enabled a collaborative approach to survey development to ensure that survey questions were clear, relevant, and accessible for our desired respondent group. The identified group of target respondents included a range of experts, including academics, ship operators, and Inuit and local knowledge holders from each of the Inuit regions of Inuit Nunangat. To ensure a strong response rate to the survey and in line with self-determined approaches to Arctic research as outlined in the National Inuit Strategy on Research (NISR) (ITK 2018), two (Inuit) Regional Research Technicians, Megan Lennie (Inuvialuit Settlement Region) and Tamar Mukyunik (Nunavut) were hired to: 1) raise awareness about the project among potential survey respondents, 2) recruit respondents, 3) facilitate survey round one by phone and video conference, 4)

securely manage data and share it with the Ottawa-based team members, 5) provide feedback and verification of preliminary results and outputs, and 6) assist with results sharing and dissemination to respondents and other regional rights holders and stakeholders. In collaboration with the Regional Research Technicians, a list of relevant shipping knowledge holders (operators, decision makers, academics) and rights holders were identified and invited to participate in the three-part survey (see Appendix A – Survey Respondents). During this phase, the project team strived to be as inclusive as possible and to document a wide range of views among a diverse range of rights holders and stakeholders. Through the first round of the survey, 58 participants identified 1) a suite of perceived strengths and weaknesses of the Corridors framework, 2) a list of potential strategies for corridors management, and 3) suggestions for guiding principles needed for effective corridors governance. Respondents were also asked to identify groups and/or institutions they believed should/could be involved in corridors management (see Appendix D).

During the **convergence phase** of the Policy Delphi approach, the management strategies identified by survey round one respondents were thematically coded and evaluated using constant comparison methodology, revealing relevant categories and to enable syntheses of responses into manageable options (Lewis-Beck et al. 2004). This synthesis of management options was presented back to the respondent group in order to validate the suite of suggestions and to provide another opportunity for respondents to make any final edits or additions to suggestions they had made. In total, 38 respondents provided feedback on the management strategies and refinements were made to thematic categories and specific management options based on this feedback. Following this step, a total of 45 management options remained and were divided among five thematic categories:

1. Governance and Regulation (GR);
2. Resources and Services (RS);
3. Knowledge Mobilization and Communication (KMC);
4. Culture and Environment (CE); and
5. Research and Monitoring (RM).

As per conventions outlined in Policy Delphi methodologies the final round of the survey involved a highly knowledgeable subset of experts from the original expert group who participated in the first two rounds of the survey. This group of 31 people made up the "expert assessment panel" and were asked to evaluate the list of identified management options for the corridors by a) considering their personal perception and expert knowledge, and b) in consideration for the outlined Government of Canada (GOC) objectives for the corridors. Expert panellists were given a clear set of criteria (i.e., rubric) across a 4-point Likert scale for evaluating each management option based on the following evaluation criteria (Table 1);

1. feasibility (i.e., combination of affordability and implementability);
2. effectiveness;
3. level of co-benefits (i.e., secondary benefits); and
4. timeframe for implementation.



Table 1 Evaluation criteria for expert assessment panel members

Evaluation Criteria	Rating 1	Rating 2	Rating 3	Rating 4
Effectiveness	**Highly effective** - strategy will be very effective in supporting corridors governance	**Somewhat effective** - strategy will be relatively effective in supporting Government of Canada corridors goals	**Limited effectiveness** - strategy will have little effect in supporting Government of Canada corridors goals	**Not effective** - strategy will have no effect to support Government of Canada corridors goals
Affordability	**Definitely affordable** - could be implemented within current fiscal realities - high cost-sharing possibilities exist	**Some indication of affordability** - some indication strategy could be implemented within current fiscal realities - some cost sharing possibilities exist	**Some indication on unaffordability** - strategy is not likely affordable under current fiscal realities - few cost sharing possibilities	**Definitely unaffordable** - strategy is not affordable and no cost sharing possibilities exist
Implementability	**No identifiable barriers - (**i.e., legal, political, institutional, social, capacity etc.), definitely can be implemented	**Some identifiable barriers** - (i.e., political, institutional, social, capacity, etc.), barriers most likely can be overcome	**Many identified barriers -** (i.e., political, institutional, social, capacity etc.), barriers may be too significant to overcome	**Obvious and significant barriers -** (i.e., political, institutional, social, capacity, etc.), definitely cannot be implemented
Co-benefits	**Significant co-benefits exist** - strategy will generate a lot of secondary benefits in addition to supporting corridors governance	**Some co-benefits exist** - strategy will generate some secondary benefits outside of corridors governance	**Few co-benefits exist** - strategy may or may not generate any secondary benefits outside of corridors governance	**No co-benefits exist** - strategy has no identifiable secondary benefits outside of corridors governance
Timeframe for implementation	**Short term** - within 2 years from now	**Medium term** - 2-7 years from now	**Long term** - 8-15 years from now (other criteria should be re-evaluated in the future)	**Very long term** - 15+ years from now (other criteria should be re-evaluated in the future)

(Adapted from Lemieux and Scott 2011; Dawson et al. 2016)

The **consensus phase** of the framework involved a multi-stage statistical analysis of results emerging from survey round three. The focus of the analysis was on identifying the *point of agreement* and the *level of consensus* among the respondent group for each of the 45 management strategies and among each of the evaluation criteria (n=5) (refer to Table 1). A point of agreement occurs when the majority of scores fall on a particular criteria level. Consensus is then measured as the degree to which the expert panel members agreed on the assessment (i.e., point of agreement) for each management strategy and for each evaluation criteria. The overall level of consensus was determined through statistical analysis of responses, and then nominally categorizing the results as high (70% of ratings in one agreement category or 80% in two related categories), medium (60% of ratings in one agreement category or 70% in two related categories), low (50% of ratings in one agreement category or 60% in related categories), and none (less than 60% of ratings in two related categories). Although it is not necessary to have consensus on suggested management strategies, if there is low or no consensus, this is an indication that that suggestion may be contentious or may require additional consideration. Table 2 provides an example/mock management strategy to outline the analytical approach taken to identify points of agreement and levels of consensus.

Table 2 Example Analysis of Management Strategy

Example/Mock Management Strategy:						
Effectiveness						
	HE	SE	LE	NE	CONSENSUS	POINT OF AGREEMENT
Responses	12	12	7	0	Medium	Highly effective to somewhat effective
% with opinion	39%	39%	23%	0%		
% like categories	77%	61%	23%			
HE Highly effective; SE=Somewhat effective; LE=Limited effectiveness; NE=Not effective.						
Affordability						
	DA	SA	SU	DU	CONSENSUS	POINT OF AGREEMENT
Responses	22	9	0	0	High	Definitely affordable
% with opinion	71%	29%	0%	0%		
% like categories	100%	29%	0%			
DA=Definitely affordable; SA=Some indication of affordability; SU=Some indication of unaffordability; DU=Definitely unaffordable.						
Implementability						
	NB	SB	MB	OB	CONSENSUS	POINT OF AGREEMENT
Responses	19	12	0	0	High	No identifiable barriers to some identifiable barriers
% with opinion	61%	39%	0%	0%		
% like categories	100%	39%	0%			
NB=No barriers; SB=Some barriers; MB=Many barriers; OB=Obvious and significant barriers						
Co-Benefits						
	SB	B	FB	NB	CONSENSUS	POINT OF AGREEMENT
Responses	12	12	7	0	Medium	Significant to some secondary benefits
% with opinion	39%	39%	23%	0%		
% like categories	77%	61%	23%			
SB=Significant co-benefits; B=Some co-benefits; FB=Few co-benefits; NB=No co-benefits						
Timeframe						
	ST	MT	LT	VT	CONSENSUS	POINT OF AGREEMENT
Responses	22	9	0	0	High	Short term
% with opinion	71%	29%	0%	0%		
% like categories	100%	29%	0%			
ST=Short term; MT=Medium term; LT=Long term; VT=Very long term						

2.3 METHODS FOR PRIORITIZING RESPONDENT-IDENTIFED MANAGEMENT STRATEGIES

In addition to identifying points of agreement and levels of consensus for each of the identified management strategies, a method was used to prioritize strategies based on key criteria. Prioritization exercises can be conducted in several different ways which can affect the end result. However, the process of prioritizing is simply an analysis exercise and the full level of prioritization and potential implementation rests with decision-makers. The prioritization efforts outlined here are designed to assist decision-makers in their own internal processes of which other criteria and considerations would certainly be included which are beyond the scope, capacity, or remit of the research team. In this analysis, prioritizing management options for the corridors is a function of both effectiveness and feasibility (i.e., which includes both affordability and implementability). The approach utilized by the research team involved the development of effectiveness-feasibility plots, which are essentially simple visualizations that can help decision-makers to quickly and easily see which strategies they may consider for implementation. For example, a certain strategy may be rated as highly effective but with limited feasibility, whereas another may be moderately effective but with high feasibility and thus the second option may be the one chosen despite its lower overall effectiveness rating. Results are displayed as a simple scatterplot on a four-quadrant grid, with mean effectiveness ratings across the x-axis and mean feasibility ratings across the y-axis (Figure 3). The location of the x- and y-axes were determined based on mean score of all effectiveness ratings (x-axis) and feasibility ratings (y-axis) for each theme. All variables that fall to the right of the y-axis have been rated as having a higher-than-average effectiveness within that theme, and the variables that are found above the x-axis have been rated to be above average in terms of feasibility. Thus, the more desirable and more feasible options are located in the top right quadrant of the scatter plot.

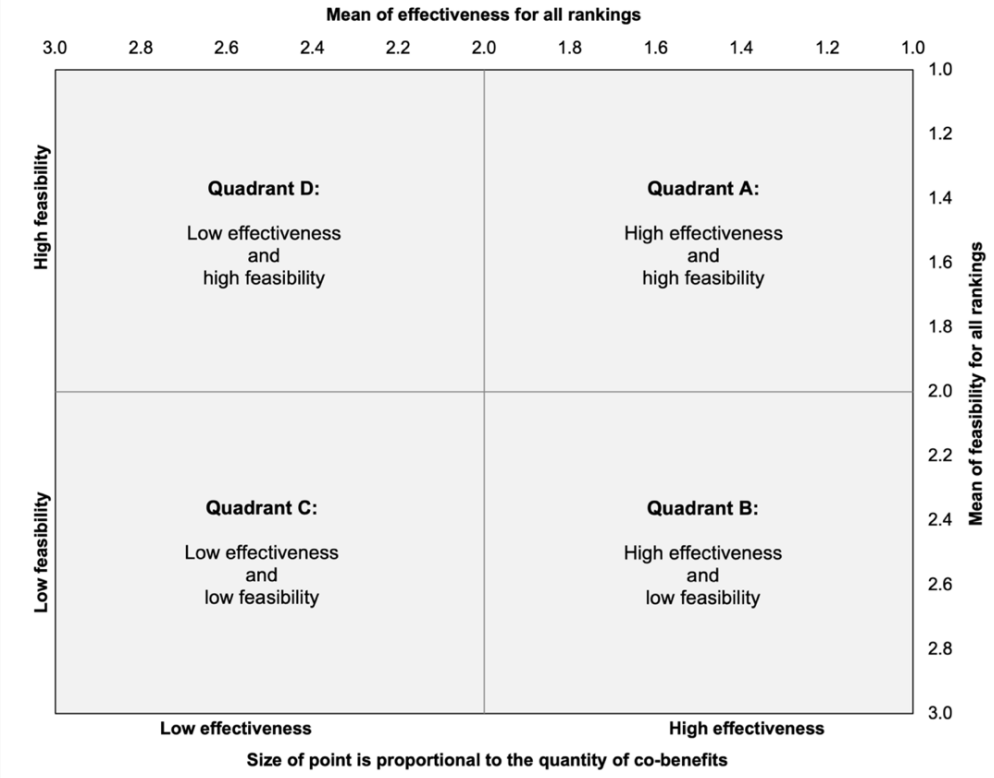


Figure 3 Example effectiveness-feasibility plot

3.0 RESULTS

In Section 3.0 a synthesis of aggregated results from the three parts of the iterative survey are presented. First, survey rounds one and three respondent demographics (sex- and Indigenous-identity, affiliation, years of experience and location), as well as respondent-identified strengths and weakness of the corridors framework, are presented. This is followed by a detailed comprehensive review of the expert panel members' assessment of the 45 respondent-identified management strategies. This includes an outline of the highest-ranked management strategies, and the management strategies that study results indicate should be the initial focus of governance efforts. Next, the consideration of divergences in opinion of expert assessment panel members in management strategy analysis is described. Respondent-identified guiding principles for implementing corridors management strategies are also presented. Lastly, a broad inventory of both novel and common potential governance bodies as identified by respondents, including the roles and responsibilities of numerous rights holder and stakeholder groups in governance body decision-making, are presented.

3.1 PARTICIPANT DEMOGRAPHICS

3.1.1 SURVEY RESPONDENT GROUP (ROUND ONE)

A total of 58 respondents participated in the first survey, which was designed to identify potential management options for corridors governance. Of the total group of respondents nearly 1/5 identified as Indigenous (most Inuit) and nearly 2/3 identified as male (Figure 4). Respondents' degree of involvement in topics related to Arctic shipping and/or Arctic policy ranged from less than one year to over 50 years with most indicating that they possessed between one and ten years of experience (Figure 4). Respondents

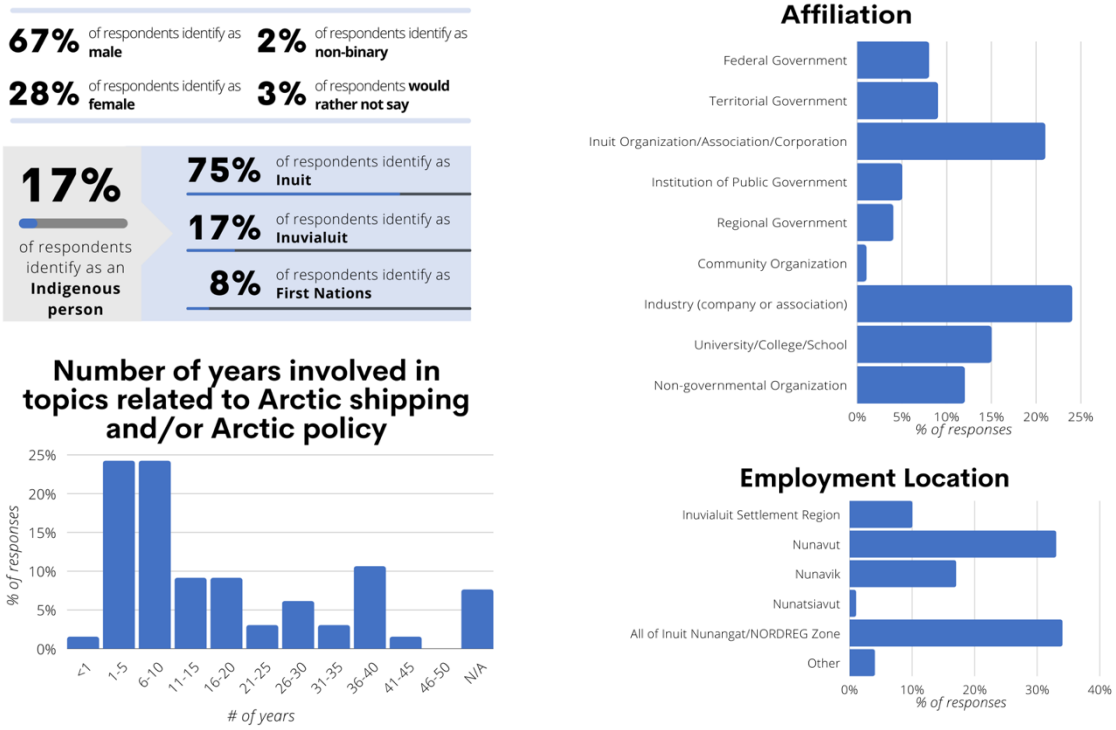


Figure 4 Survey respondent group (round 1) information

were affiliated with a broad range of organizations including federal, territorial, and regional government; Inuit organizations, associations, and corporations; Institutions of Public Government; community organizations; industry; universities, colleges, and schools; and non-governmental organizations (Figure 4). Most respondents were affiliated with Inuit organizations, associations, and corporations or industry. In terms of geographic scope, most respondents indicated that they tend to work across the entire Canadian Arctic region, followed by Nunavut, and then Nunavik (Figure 4).

3.1.2 SURVEY RESPONDENT GROUP (ROUND TWO)

Demographic information of the respondent group of survey round two was not collected. However, as the purpose of survey round two was to identify any missing ideas and to confirm the synthesis and analysis (thematic organization and constant comparison) of strategies that were identified in survey round one, the profile of this respondent group is likely to be highly similar to round one.

3.1.3 EXPERT ASSESSMENT PANEL (ROUND THREE)

Information gathered through survey round three reflects the views of 31 experts of whom none identify as Indigenous, nearly 1/3 identify as female, and most identify as male (Figure 5). Expert panel members' degree of involvement in topics related to Arctic shipping and/or Arctic policy ranged from one year to 50 years (Figure 5) with the highest number having one to ten years of experience. Expert panel members represented a broad range of affiliations including federal, territorial, and regional government; Inuit organizations, associations, and corporations; Institutions of Public Government; industry; universities, colleges, and schools; as well as non-governmental organizations (NGO). The highest number were affiliated with the federal government, industry, and NGOs (Figure 5). Nine expert panel members identified more than one affiliation. Of these, two expert panel members had four affiliations; four expert panel members had three affiliations; and three expert panel members had two affiliations. Expert panel members worked in three regions of Inuit Nunangat and beyond including Inuvialuit Settlement Region, Nunavut, Nunavik, and all of Inuit Nunangat or the NORDREG Zone. The highest number of expert panel members worked in all of Inuit Nunangat or the NORDREG Zone (Figure 5).

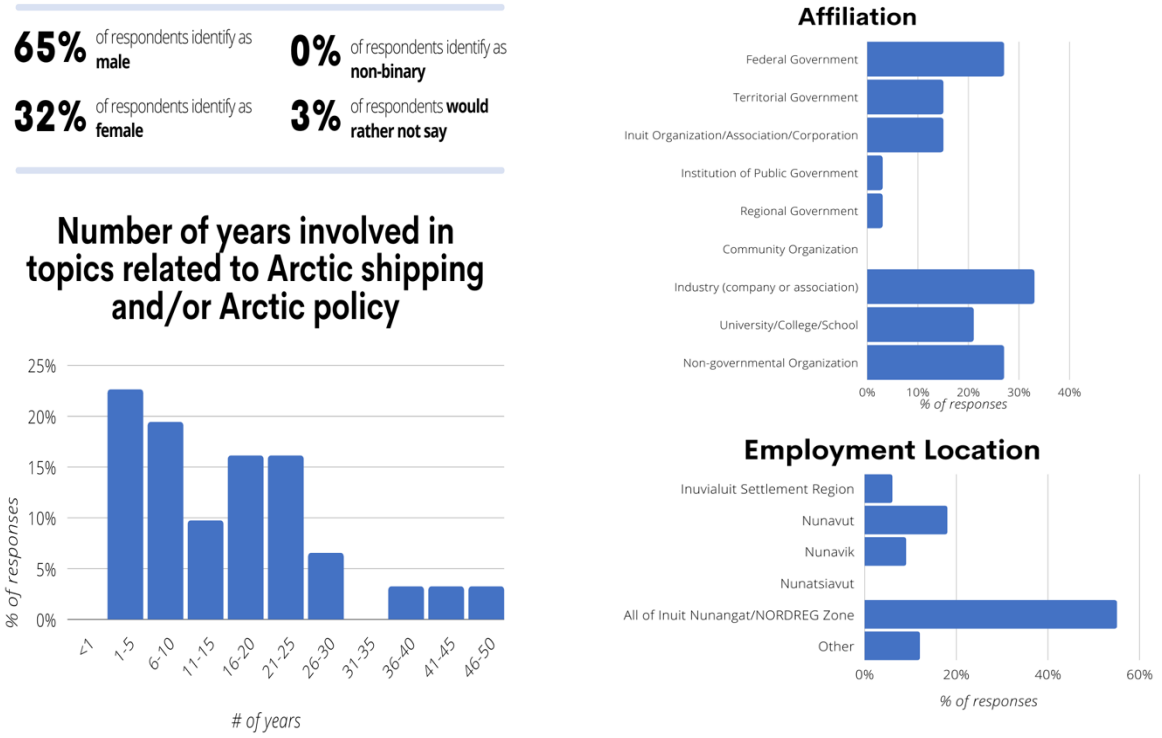


Figure 5 Expert assessment panel member (round three) information

3.2 STRENGTHS AND WEAKNESSES OF THE CORRIDORS FRAMEWORK

Respondents from surveys round one and two identified over 130 strengths and over 90 weaknesses with respect to the corridors initiative generally (see summary in Table 3). The analysis revealed a very wide range of perceptions where some respondents shared similar ideas and others expressed very unique and divergent viewpoints. We present here a synthesized thematically organized analysis of the responses, which are dived into categories based on the GOC's stated and publicly articulated goals for the corridors (see Section 1.1 Background). This analysis revealed a total of 14 strengths and 17 weaknesses that are organized below based on the GOC's corridor goals:

1) enhanced marine navigation safety,
2) minimizing ecological and cultural impacts,
3) guiding investment, and
4) collaborative management.

The strengths outlined here can support the GOC's achievement of those goals and the weaknesses highlight areas of opportunity for consideration during future implementation efforts. It is important to note that perspectives were varied and at times opposing; a reflection of the wide range of expertise and perspectives respondents contributed to the iterative survey process. We present the full spectrum of opinions in order to illustrate the unique and varied voices of survey respondents for consideration. These points can serve as guidance for future discussions, outlining areas of convergence and divergence which may require further investigation.

For the goal of **enhancing marine navigation safety**, the number of weaknesses (n=6) outnumbered the number of strengths (n=4). Weaknesses included issues related to compliance, the limited applicability to cruise ship traffic, the dynamic nature of the corridors, the need for a comprehensive monitoring system, the need for charting both in and outside of the corridors, and the physical size and placement of the corridors. In contrast, strengths included topics surrounding the voluntary nature of the corridors, improved communication and navigational support, as well as enhanced navigational safety and guidance for ships.

For the goal of **minimizing ecological and cultural impacts** there were fewer weakness (n=3) than strengths (n=4). Weaknesses included viewpoints surrounding the need for discussions about shipping traffic beyond the corridors, corridors passing through protected areas and regions, and the insufficient documentation of Inuit and local knowledge to enable planning. Strengths included that the corridors framework provide a foundation for reducing the impact of marine vessel traffic and affords value to and utilizes Indigenous knowledge. The corridors can also support food security and adaptive wildlife management.

A greater number of weaknesses (n=4) than strengths (3) were articulated related to **guiding investment**. One weakness was the significant degree of resources the corridors will require. There were opposing viewpoints regarding whether or not the corridors approach would harmonize economic development, Indigenous priorities, and environmental protection. A strength was the corridors providing a framework for regional development and investment, and a related weakness was that the corridors would not be a primary driver of development and investment. A strength was the focused deployment of federal resources, whereas a weakness was the potential impact of vessel re-routing on existing economic activity.

Lastly, the goal of **collaborative management** revealed more weaknesses (n=4) than strengths (n=3). Weaknesses included the complexity of the operating environment and interregional coordination challenges, as well as reflections on the corridors development process to date and potential challenges related to budgetary and communication limitations. Strengths were focused on the vision, national governance structure and framework that the corridors provide, as well as the opportunity the corridors afford related to innovative approaches and Canada's leadership in global marine policy.

Table 3 Summary of identified strengths and weaknesses of the Corridors framework

Enhanced Marine Navigation Safety	**Strengths**	Voluntary nature of the corridors enables vessel operators to be responsive to changing environmental conditions and avoid hazards by transiting outside the corridors when needed.
		Helps to concentrate (improved) communication and navigational support, including charting, required to foster safer shipping in the region, thus strengthening Canada's position as a global northern stakeholder.
		Increases navigational safety for vessels to use (at their discretion) when voyage-planning and operating in Canadian Arctic waters. Also supports pre-season preparation and quicker response to incidents.
		Simple, graphical way of providing guidance for ships on where they should go, and (Arctic community-identified) areas of concern to bypass.
	Weaknesses	Compliance among ship operators may be a challenge as corridors are voluntary. Finding innovative approaches to compliance/conformity monitoring and communication with vessels will be critical to success.
		Cruise operators may actively avoid these corridors. The corridors framework does little to address the safety concerns raised by cruise ship traffic.
		Keeping corridors up to date, making the corridors dynamic (temporally), collecting and integrating data, as well as communicating changes and anomalous events could be challenging.

		A comprehensive monitoring system is required. Simply drawing lines on a map/chart indicating boundaries is not enough; without a strong AIS-based monitoring and surveillance system, as a waterways system the corridors will not be effective. A public-private partnership is needed, like the Marine Exchange of Alaska where industry, the United States Coast Guard, and the State of Alaska are partners in an effective ship-tracking system.
		Concentrating most of the 21st century charting in the corridors will lead to potential marine accidents/disasters. With a voluntary system, vessels will venture outside the corridors. Charting the corridors must be only the first step in a larger charting plan. A development plan for additional charting, outside of the corridors, is missing.
		The focus (physical size and placement) of the corridors is too narrow. They do not allow flexibility for normal navigation in ice-free conditions as well as in ice-covered conditions and may also cause congestion and detract from tourism experiences. This may increasingly be an issue due to climate changes and as historic shipping season dates change. The circumstances under which vessels may deviate from the corridors are not clearly laid out.
Minimizing Ecological and Cultural Impacts	**Strengths**	Provides a foundation for measures to reduce the negative impact of vessel operations in the Arctic.
		Values and utilizes Inuit and other Indigenous knowledge to identify local concerns and support decisions about corridor location and management.
		Will support solutions to northern food insecurity by mitigating negative impacts on wildlife and harvesting areas.
		Could be used as a tool for adaptive management of wildlife and the marine environment.
	Weaknesses	Although corridors are important, understanding wider spread effects of shipping traffic beyond the corridors needs to be part of the conversation, with the ability to alter corridors if required.
		Corridors currently pass through protected areas and regions identified as culturally and ecologically significant. If Canada is to have effective corridors system in Arctic waters, many will pass through culturally and ecologically significant areas; this cannot be avoided unless Canada closes these waters to all traffic.
		Inuit and local knowledge are not sufficiently documented to enable strategic planning in remote areas.
Guiding Investment	**Strengths**	Provides an opportunity to harmonize economic development, Indigenous community priorities, and environmental protection.
		Provides a comprehensive framework for regional development and infrastructure investment.
		Helps to focus deployment of limited federal resources for service delivery, search and rescue (SAR) including monitoring and emergency response (to spills, groundings etc.).
	Weaknesses	Significant resources (capital, infrastructure, and human) will be required to provide the needed extensive coverage
		Harmonizing economic development, Indigenous community priorities, and environmental protection is neither possible nor feasible with the corridor approach. All of these are driven by multiple external factors, not navigation rules and regulations.
		The corridors framework will not be a primary driver of regional development and infrastructure investment.
		Corridors placement resulting in vessel re-routing may impact existing economic activity such as commercial fishing or community re-supply.
Collaborative Management	**Strengths**	Sets a vision and provides one platform i.e. a national governance structure, for management of Arctic shipping, taking into account social, Indigenous,

		environmental, and logistical considerations, and supports responsive, adaptive planning and refinement to respond to rights holder and stakeholder priorities.
		Provides a framework under which Inuit and Government of Canada can try new models for shared operations including, potentially, shared authority for monitoring and reporting.
		Provides an opportunity to try innovative approaches and establish Canada as a world leader in circumpolar marine policy.
	Weaknesses	The complexity of the operating environment may make governance a challenge. The regulatory complexity of the region may not be addressed by the corridors approach.
		The process for developing corridors has lacked transparency and has not always included all stakeholders and rights holders appropriately. This may delay implementation and generate opposition and a lack of compliance.
		The ongoing development of navigable corridors may lack input from ship operators due to budgetary constraints and failure to effectively communicate.
		Interregional coordination may be a challenge.

3.3 DETAILED ASSESSMENT OF RESPONDENT-IDENTIFIED MANAGEMENT STRATEGIES

3.3.1 ASSESSMENT OF GOVERNANCE AND REGULATION STRATEGIES

The expert panel assessed 15 management strategies related to Governance and Regulation (Table 4). Four of these achieved high or medium consensus among the panel, as being highly effective to somewhat effective. Creating an Arctic pilotage authority; creating a national corridor working group; creating corridors task teams to focus on specific needs; and making the use of the corridors mandatory, are the management strategies with the highest consensus for effectiveness. An additional six strategies had high consensus as being somewhat effective. These included developing dynamic, regularly evaluated official, publicly available corridors strategy and implementation plans; making corridors placement dynamic and responsive; and annually evaluating the impacts of marine shipping on Arctic communities. These also included federal government Regional Inuit Organizations (RIO) co-management of the corridors, as well as incorporating Proactive Vessel Management (PVM) initiative, and Enhanced Maritime Situational Awareness (EMSA) initiative into the corridors framework. Table 4 displays the Governance and Regulation management strategies grouped by point of agreement regarding their effectiveness, and also consideration of consensus. The feasibility (i.e., affordability and implementability) (probably feasible, neutral, or probably not feasible), co-benefits (significant co-benefits exist, to some co-benefits, to few co-benefits exist), and timeframe for implementation (short term, to medium to long term) point of agreement assessments are also provided.

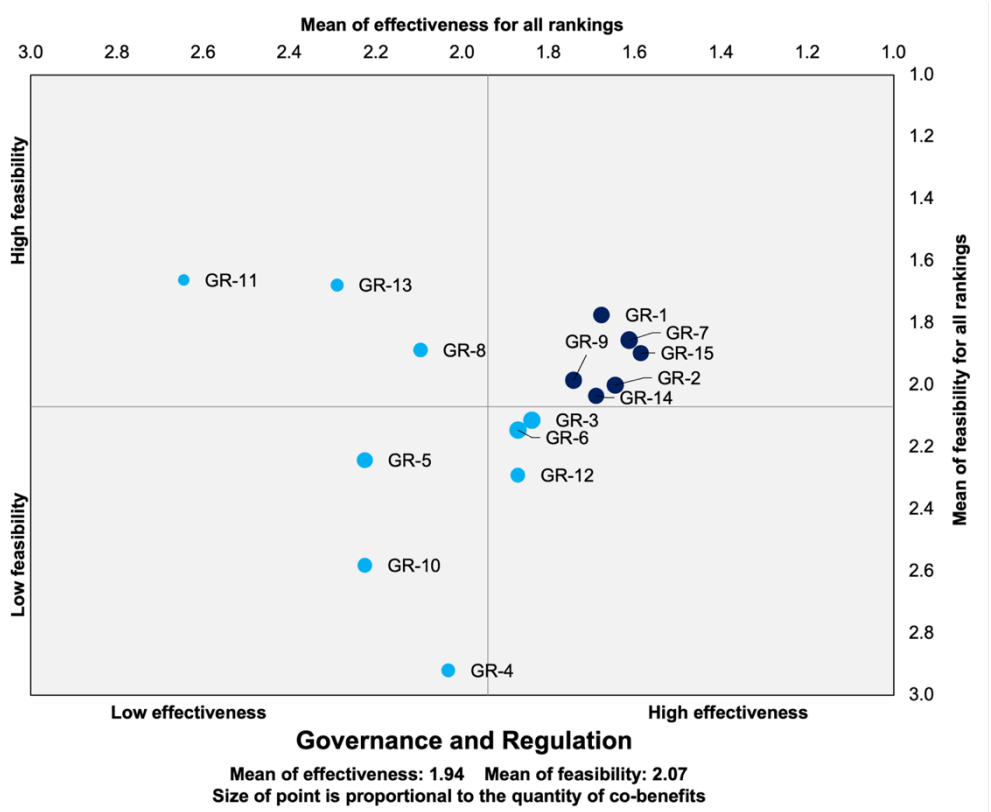
Table 4 Assessment of Governance and Regulation management strategies

Governance and Regulation						
		Point of Agreement				
Suggested management strategy		Effectiveness	Effectiveness Consensus	Feasibility	Co-benefits	Timeframe
GR-7	Create an official national corridors working group or committee (with regional representation) that includes federal and territorial governments, Inuit, and ship operators	Highly effective to somewhat effective	High	Neutral	Significant co-benefits exist	Medium term
GR-9	Create corridors task teams / sub-committees to focus on specific needs such as, identification of charting needs, pilotage needs, vessel traffic services (VTS), navigational needs, infrastructure needs, search and rescue (SAR) needs and others	Highly effective to somewhat effective	High	Neutral	Significant co-benefits exist	Short to medium term
GR-10	Increase local authorities' power so they can deal with non-compliance by ship operators within the corridors framework	Highly effective to somewhat effective	Low	Neutral	Significant to some co-benefits exist	Medium to long term
GR-12	Use of the corridors will be mandatory unless there is a clear safety reason not to use them	Highly effective to somewhat effective	Medium	Neutral	Significant to some co-benefits exist	Medium term
GR-4	Establish and implement an Arctic pilotage authority in/for the Canadian Arctic	Highly effective to somewhat effective	Medium	Probably not feasible	Some to few co-benefits exist	Medium to long term
GR-3	The impacts of marine shipping on Arctic communities will be evaluated annually	Somewhat effective	High	Neutral	Significant co-benefits exist	Medium term
GR-6	Corridors will be co-managed among relevant federal government agencies and the Regional Inuit Organizations (RIO)	Somewhat effective	High	Neutral	Significant co-benefits exist	Medium to long term

GR-14	Incorporate Proactive Vessel Management initiative (PVM) into the corridors framework	Somewhat effective	High	Neutral	Significant to some co-benefits exist	Short to medium term
GR-15	Incorporate Enhanced Maritime Situational Awareness initiative (EMSA) into the corridors framework	Somewhat effective	High	Neutral	Significant to some co-benefits exist	Short to medium term
GR-2	Corridors placement will be dynamic (not static) and regularly updated based on stakeholder (ship operators) and rightsholder (Indigenous groups) feedback	Somewhat effective	High	Probably feasible	Significant co-benefits exist	Medium to long term
GR-1	Develop official and publicly available corridors strategy and implementation plans that are dynamic and regularly evaluated	Somewhat effective	High	Probably feasible	Some co-benefits exist	Medium term
GR-8	Instead of developing a national corridor working group/committee (see above), manage the corridors within institutional structures that already exist (i.e., to avoid bureaucracy)	Somewhat effective	Medium	Probably feasible	Some co-benefits exist	Short term
GR-11	Corridors will remain completely voluntary and will not be used to 'restrict' ship operations, activities, or movements	Somewhat effective to limited effectiveness	High	Probably feasible	Some to few co-benefits exist	Short term
GR-5	Corridors will be co-managed among relevant federal government agencies and the national Inuit organization (Inuit Tapiriit Kanatami)	Somewhat effective to limited effectiveness	Medium	Neutral	Some co-benefits exist	Medium to long term
GR-13	No new regulatory policies will be created to support corridors management /governance (i.e., existing mechanisms are sufficient)	Somewhat effective to limited effectiveness	Medium	Probably feasible	Some co-benefits exist	Short term

3.3.2 EFFECTIVENESS-FEASIBILITY PLOT FOR GOVERNANCE AND REGULATION STRATEGIES

Figure 6 displays the effectiveness-feasibility plot (see Section 2.3) for management strategies in the Governance and Regulation theme. Six strategies fall within Quadrant A (high effectiveness and high feasibility), suggesting that these should be the initial focus of governance efforts; and of these all have significant co-benefits. These highly feasible, highly effective strategies include developing dynamic corridors that are regularly evaluated, publicly available (GR-1), and incorporate rights and stake holder feedback (GR-2). Also included are strategies surrounding the creation of national and niche working groups (GR-7; GR-9), and the incorporation of existing maritime initiatives into the corridors (GR-15; GR-15). Items in Quadrant C are low effectiveness and low feasibility, suggesting they should not be considered in governance efforts unless there is another compelling reason to do so. These relate to federal agencies and Inuit Tapiriit Kanatami co-managing the corridors, and the implementation of a Canadian Arctic pilotage authority, as well as increasing local authorities' power regarding ship non-compliance.



Legend	
GR-1	Develop official and publicly available corridors strategy and implementation plans that are dynamic and regularly evaluated
GR-2	Corridors placement will be dynamic (not static) and regularly updated based on stakeholder (ship operators) and rights holder (Indigenous groups) feedback
GR-7	Create an official national corridors working group/committee (with regional representation) that includes federal and territorial governments, Inuit, and ship operators
GR-9	Create corridors task teams / sub-committees to focus on specific needs such as, identification of charting needs, pilotage needs, vessel traffic services (VTS), navigational needs, infrastructure needs, search and rescue (SAR) needs and others
GR-14	Incorporate Proactive Vessel Management initiative (PVM) into the corridors framework
GR-15	Incorporate Enhanced Maritime Situational Awareness initiative (EMSA) into the corridors framework

Figure 6 Effectiveness-feasibility for Governance and Regulation management strategies

3.3.3 EVALUATION OF RESOURCES AND SERVICES STRATEGIES

Eleven corridors management strategies related to Resources and Services were assessed by the expert panel (Table 5). Five of these achieved high consensus as highly effective. Establishing a 'one-stop-shop' public corridors website; modern charting; digital communications infrastructure; and navigation aids, as well as community-level training related to fuel kits are the areas with the highest consensus for effectiveness. Three additional strategies had high consensus as highly effective to somewhat effective. These include investing in weather instrumentation; investing in a satellite-based Automatic Identification System (AIS); and voyage planning tools. Table 5 displays the Resources and Services management strategies grouped by point of agreement regarding their effectiveness and consensus. The feasibility (i.e., affordability and implementability) (probably feasible, neutral, or probably not feasible), co-benefits (significant co-benefits exist, to some co-benefits exist) and timeframe for implementation (short to medium term, to medium to long term) points of agreement are also provided.

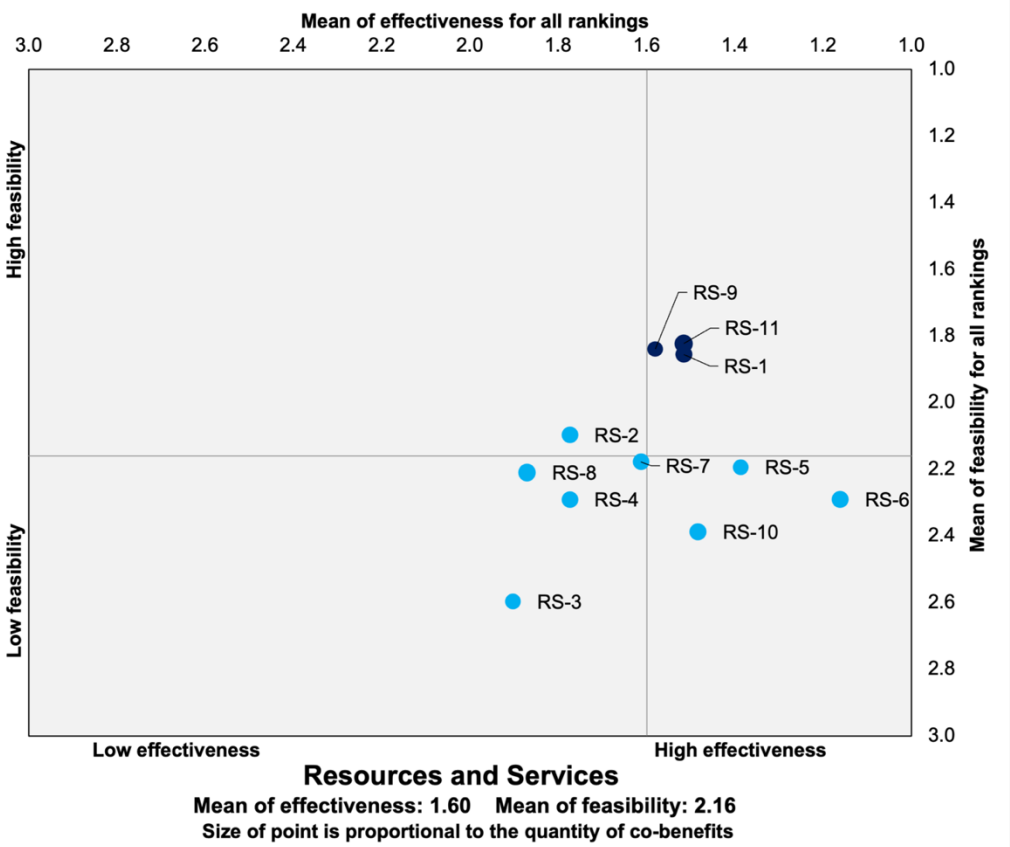
Table 5 Resources and Services management strategies

Resources and Services						
		Point of Agreement				
Suggested management strategy		Effectiveness	Effectiveness Consensus	Feasibility	Co-benefits	Timeframe
RS-1	Establish a public website for corridors that acts as a 'one stop shop' for information on corridor use, shipping trends, impacts, significant areas (ecologically and culturally), best practices, suggested routes, areas to avoid, pollution restrictions, fuel requirements, notices to mariners, voyage planning, bulletins, information on Inuit Nunangat communities etc.	Highly effective	High	Neutral	Significant co-benefits exist	Medium term
RS-6	Invest in and ensure modern charting exists throughout the entire corridors system	Highly effective	High	Neutral	Significant co-benefits exist	Medium to long term
RS-10	Invest in and establish a reliable and robust network of digital communications infrastructure to support the entire corridors system	Highly effective	High	Neutral	Significant co-benefits exist	Medium to long term
RS-11	Provide continual training for Inuit and northerners in Inuit Nunangat communities to use the fuel spill kits specifically placed along the corridors and clearly outline who is responsible for which kit	Highly effective	High	Neutral	Significant co-benefits exist	Short to medium term

RS-5	Invest in and modernize navigation aids throughout the entire corridors system	Highly effective	High	Neutral	Significant to some co-benefits exist	Medium to long term
RS-7	Invest in extensive weather instrumentation that is on par with other Canadian regions along the corridors to enable better environmental forecasting	Highly effective to somewhat effective	High	Neutral	Significant co-benefits exist	Medium to long term
RS-2	Invest in a system that provides all coastal communities in Inuit Nunangat with real-time access to **satellite-based** Automatic Identification System (AIS) real-time ship movement data that enables locally based ship monitoring	Highly effective to somewhat effective	High	Neutral	Significant to some co-benefits exist	Medium term
RS-9	Establish and offer free access to voyage planning tools (including access to state of the art environmental forecasting data) for ship operators using the corridors	Highly effective to somewhat effective	High	Neutral	Some co-benefits exist	Medium term
RS-8	Create new funding models (including wages for deployments) for the Coast Guard Auxiliary's new Arctic chapter that allows units to pre-deploy along the Corridor during busy periods	Highly effective to somewhat effective	Medium	Neutral	Significant co-benefits exist	Medium term
RS-3	Invest in a system of **shore-based** AIS stations with provisions for regular maintenance and technical support to enable real-time monitoring of ship movements	Highly effective to somewhat effective	Medium	Neutral	Significant to some co-benefits exist	Medium to long term
RS-4	Expand the Inuit Marine Monitoring Program to cover the entire corridors system	Somewhat effective	High	Neutral	Significant co-benefits exist	Medium to long term

3.3.4 EFFECTIVENESS-FEASIBILITY PLOT FOR RESOURCES AND SERVICES STRATEGIES

Figure 7 displays the effectiveness-feasibility plot for strategies in the Resources and Services theme. Three closely grouped strategies fall within Quadrant A (high effectiveness and high feasibility), suggesting that these should be the initial focus of governance efforts. Moreover two of these, establishing a 'one stop shop' public website for corridors-related information (RS-1), and training for Inuit and northerners to use fuel spill kits placed along the corridors (RS-11), have significant co-benefits. One quarter of the strategies are located in Quadrant B, indicating low feasibility and high effectiveness, however RS-5 (investing in and modernizing corridors navigation aids) sits near the line between categories, indicating that this strategy should be investigated closely to see if there is reason to move it into Quadrant A. One third of the strategies are in Quadrant C, suggesting that given they were ranked as low effectiveness and low feasibility, they should not be considered in governance efforts.



Legend	
RS-1	Establish a public website for corridors that acts as a 'one stop shop' for information on corridor use, shipping trends, impacts, significant areas (ecologically and culturally), best practices, suggested routes, areas to avoid, pollution restrictions, fuel requirements, notices to mariners, voyage planning, bulletins, information on Inuit Nunangat communities etc.
RS-9	Establish and offer free access to voyage planning tools (including access to state of the art environmental forecasting data) for ship operators using the corridors
RS-11	Provide continual training for Inuit and northerners in Inuit Nunangat communities to use the fuel spill kits specifically placed along the corridors and clearly outline who is responsible for which kit

Figure 7 Effectiveness-feasibility for Resources and Services management strategies

3.3.5 EVALUATION OF KNOWLEDGE MOBILIZATION AND COMMUNICATION STRATEGIES

Eight corridors management strategies related to Knowledge Mobilization and Communication were assessed by the expert panel (Table 6). Two of these achieved high consensus as highly effective. Provision of digital maps and establishing a point of contact with Inuit Nunangat communities are the areas with the highest consensus for effectiveness. Three additional strategies had high or medium consensus as highly effective to somewhat effective. These include employing Inuit in monitoring and liaison positions year-round, creating educational materials for communities, and making information publicly available concerning non-compliant vessels. Table 6 displays the Knowledge Mobilization and Communication management strategies grouped by point of agreement regarding their effectiveness and consensus. The feasibility (i.e., affordability and implementability) (probably feasible, neutral, or probably not feasible), co-benefits (significant co-benefits exist, to some co-benefits exist), and timeframe for implementation (short term, to medium to long term) points of agreement are also provided.

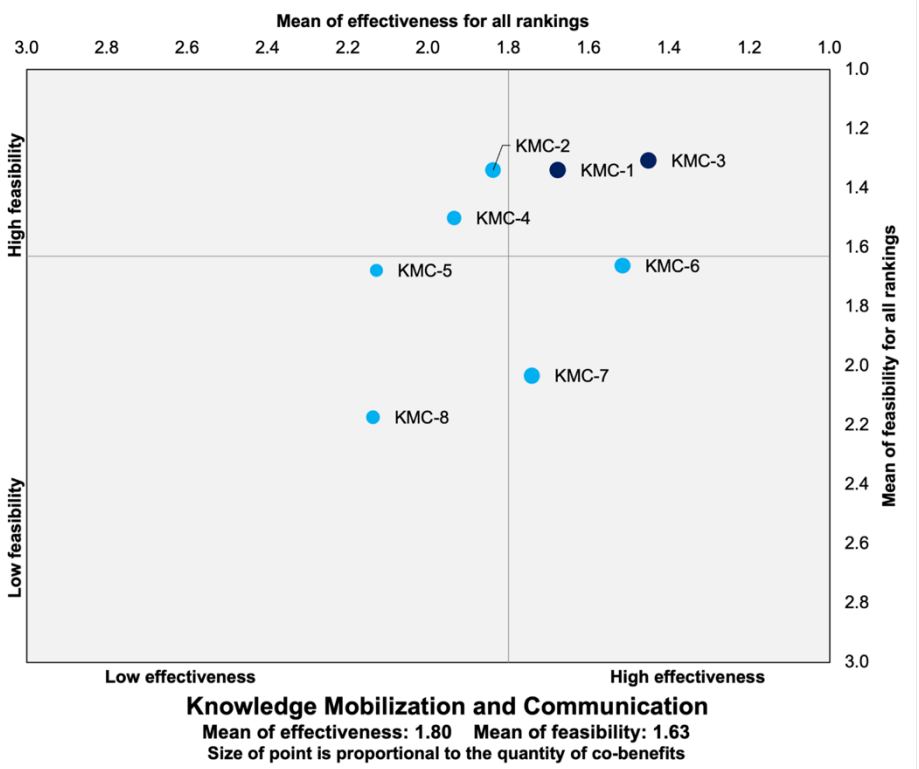
Table 6 Knowledge Mobilization and Communication management strategies

Knowledge Mobilization and Communication						
		Point of Agreement				
Suggested management strategy		Effectiveness	Effectiveness Consensus	Feasibility	Co-benefits	Timeframe
KMC-6	Provide freely available and easy to access digital maps of the corridors (including significant areas, and Inuit-identified recommendations for operation (e.g. slow zones, no-anchor zones) to all operators for their consideration during pre-trip planning and for real-time navigational decisions	Highly effective	High	Probably feasible	Significant co-benefits exist	Medium term
KMC-3	Establish a single point of contact that Inuit Nunangat community members can connect with if they observe non-compliance of regulations	Highly effective	High	Probably feasible	Significant co-benefits exist	Short term
KMC-7	Employ Inuit in each settled land claim region year-round to answer community questions about shipping, monitor AIS	Highly effective to somewhat effective	High	Neutral	Significant co-benefits exist	Short to medium term

	and traffic trends, update local perspectives, map culturally significant marine areas (CSMA), communicate with ship operators when needed, etc.					
KMC-2	Create educational materials for communities in Inuit Nunangat to better understand ship operators' constraints and needs to ensure safe and sustainable practices	Highly effective to somewhat effective	Medium	Probably feasible	Significant to some co-benefits exist	Short term
KMC-5	Publicly share the names of vessels that regularly violate regulations in the corridors (i.e. so all ships are not blamed for poor decisions among a few)	Highly effective to somewhat effective	Medium	Probably feasible	Some to few co-benefits exist	Short term
KMC-8	Establish a compliance-certification program for the corridors based on the principals and success of the Marine Stewardship Council (MSC) certification for sustainable fisheries	Somewhat effective	High	Neutral	Some co-benefits exist	Medium to long term
KMC-1	Include Inuit and community perspectives on ship operations at the northern Canadian Marine Advisory Council (CMAC) annual meetings as a standing topic for discussion and inclusion	Somewhat effective	High	Probably feasible	Significant co-benefits exist	Short term
KMC-4	Improve public and international understanding of the objectives, role, and value of the corridors	Somewhat effective	High	Probably feasible	Some co-benefits exist	Short to medium term

3.3.6 EFFECTIVENESS-FEASIBILITY PLOT FOR KNOWLEDGE MOBILIZATION AND COMMUNICATION STRATEGIES

Figure 8 displays the effectiveness-feasibility plot for strategies in the Knowledge Mobilization and Communication theme. Two strategies fall within Quadrant A (high effectiveness and high feasibility), suggesting that these should be the initial focus of governance efforts. These involve leveraging northern Canadian Marine Advisory Council (CMAC) annual meetings as a forum for Inuit and community perspectives on ship operations to be heard (KMC-1), and establishing a point of contact to enable Inuit Nunangat communities to report observations of non-compliance of corridors regulations (KMC-3). For both, significant co-benefits exist. Two strategies, are located in Quadrant B (high effectiveness and low feasibility), one of which sits near the line between categories (KMC-6) and for which significant co-benefits exist, so should be investigated closely to see if there is reason to move it into Quadrant A. This strategy involves providing freely available and easy to access digital maps of the corridors, including significant areas, and Inuit-identified recommendations for operation (e.g., slow zones, no-anchor zones) to all operators for their consideration during pre-trip planning and for real-time navigational decisions. The low feasibility and low effectiveness of publicly sharing the names of vessels that regularly violate regulations in the corridors (KMC-5) and establishing a compliance-certification program for the corridors based on the principals and success of the Marine Stewardship Council (MSC) certification for sustainable fisheries (KMC-8), suggest these strategies should not be the focus of governance efforts.



Legend	
KMC-1	Include Inuit and community perspectives on ship operations at the northern Canadian Marine Advisory Council (CMAC) annual meetings as a standing topic for discussion and inclusion
KMC-3	Establish a single point of contact that Inuit Nunangat community members can connect with if they observe non-compliance of regulations

Figure 8 Effectiveness-feasibility for Knowledge Mobilization and Communication management strategies

3.3.7 EVALUATION OF CULTURE AND ENVIRONMENT STRATEGIES

Five corridors management strategies related to Culture and Environment were assessed by the expert panel (Table 7). None of these achieved high consensus as highly effective. Two strategies had high consensus as highly effective to somewhat effective. These include establishing a system for sharing real-time information on marine mammal and harvesting activities, and regularly sharing culturally significant marine areas with ship operators. Two additional strategies had high consensus as somewhat effective: further developing the existing set of culturally significant marine areas (CSMAs), and creation of a corridors environmental protection fund. Table 7 displays the Culture and Environment management strategies grouped by point of agreement regarding their effectiveness and consensus. The feasibility (i.e., affordability and implementability) (probably feasible, neutral, or probably not feasible), co-benefits (significant, to significant to some co-benefits exist) and timeframe for implementation (medium term, to medium to long term) points of agreement are also provided.

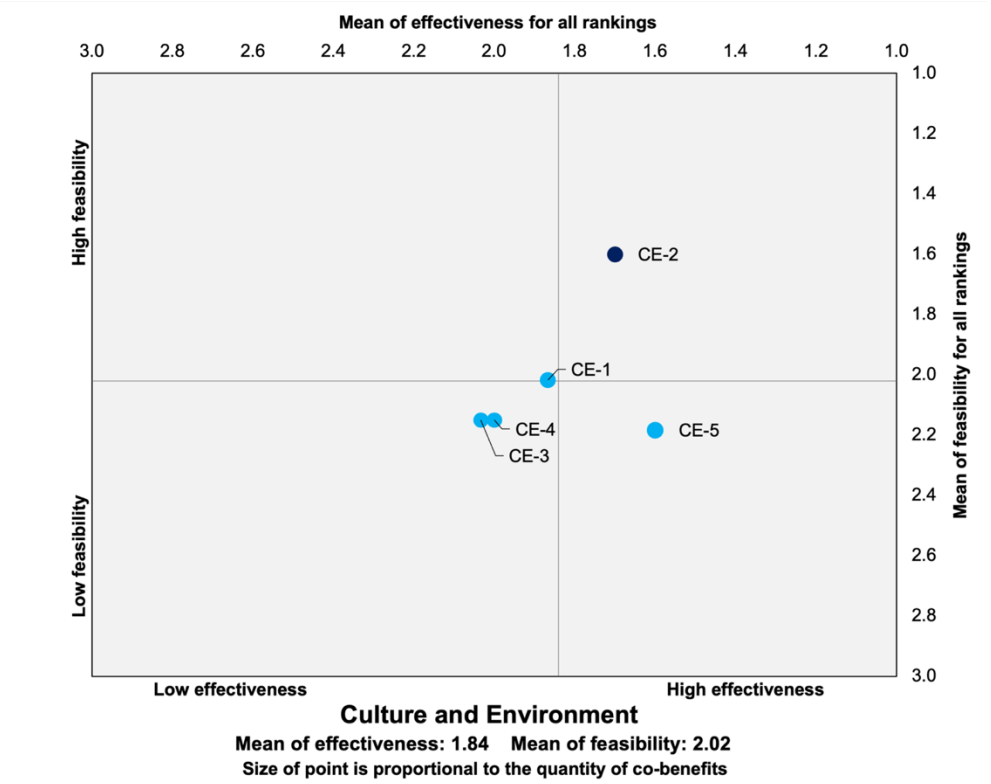
Table 7 Culture and Environment management strategies

Culture and Environment						
		Point of Agreement				
Suggested management strategy		Effectiveness	Effectiveness Consensus	Feasibility	Co-benefits	Timeframe
CE-5	Establish a reliable system for sharing real-time information on marine mammal locations as well as ongoing hunting and harvesting activities by Inuit hunters to ship operators, so operators can avoid these areas when possible	Highly effective to somewhat effective	High	Neutral	Significant co-benefits exist	Medium to long term
CE-2	Key features in the corridors including Culturally Significant Marine Areas (CSMAs) and Ecologically and Biologically Significant Areas (EBSAs) will be regularly shared (including updates) with ship operators for consideration when navigating in the area	Highly effective to somewhat effective	High	Probably feasible	Significant to some co-benefits exist	Medium term
CE-1	Develop an official set of 'Culturally Significant Marine Areas' (CSMAs) by utilizing and extending	Somewhat effective	High	Neutral	Significant to some co-benefits exist	Medium term

	existing research and government initiatives					
CE-4	Create a corridors environmental protection fund that can be accessed for local initiatives (research, monitoring, other programs)	Somewhat effective	High	Neutral	Significant to some co-benefits exist	Medium to long term
CE-3	Create an environmental protection committee for the corridors that includes stakeholders and rightsholders	Somewhat effective to limited effectiveness	Medium	Neutral	Significant to some co-benefits exist	Medium term

3.3.8 EFFECTIVENESS-FEASIBILITY PLOT FOR CULTURE AND ENVIRONMENT STRATEGIES

Figure 9 displays the effectiveness-feasibility plot for strategies in the Culture and Environment theme. One strategy falls within Quadrant A (high effectiveness and high feasibility), and significant co-benefits exist, suggesting that ensuring key features in the corridors including Culturally Significant Marine Areas (CSMAs) and Ecologically and Biologically Significant Areas (EBSA) are regularly shared with ship operators for consideration when navigating in the area (CE-2) should be the initial focus of governance efforts. In tandem with this is the development of an official set of CSMAs by utilizing and extending existing research and government initiatives (CE-1), located on the line dividing quadrants C and D, suggested further investigation of this strategy may be warranted. The Culture and Environment strategies involving creating a corridors environmental protection fund that can be accessed for local initiatives (research, monitoring, other programs; CE-4) and creating an environmental protection committee for the corridors that includes stakeholders and rightsholders (CE-3) were assessed as low feasibility and near the high effectiveness line. Current legal and moral imperatives for inclusion of Indigenous Peoples in Canada's perspectives and knowledge in decision-making affecting them and their homelands suggests further exploration of these strategies is warranted.



Legend	
CE-2	Key features in the corridors including Culturally Significant Marine Areas (CSMAs) and Ecologically and Biologically Significant Areas (EBSAs) will be regularly shared (including updates) with ship operators for consideration when navigating in the area.

Figure 9 Effectiveness-feasibility for Culture and Environment management strategies

3.3.9 EVALUATION OF RESEARCH AND MONITORING STRATEGIES

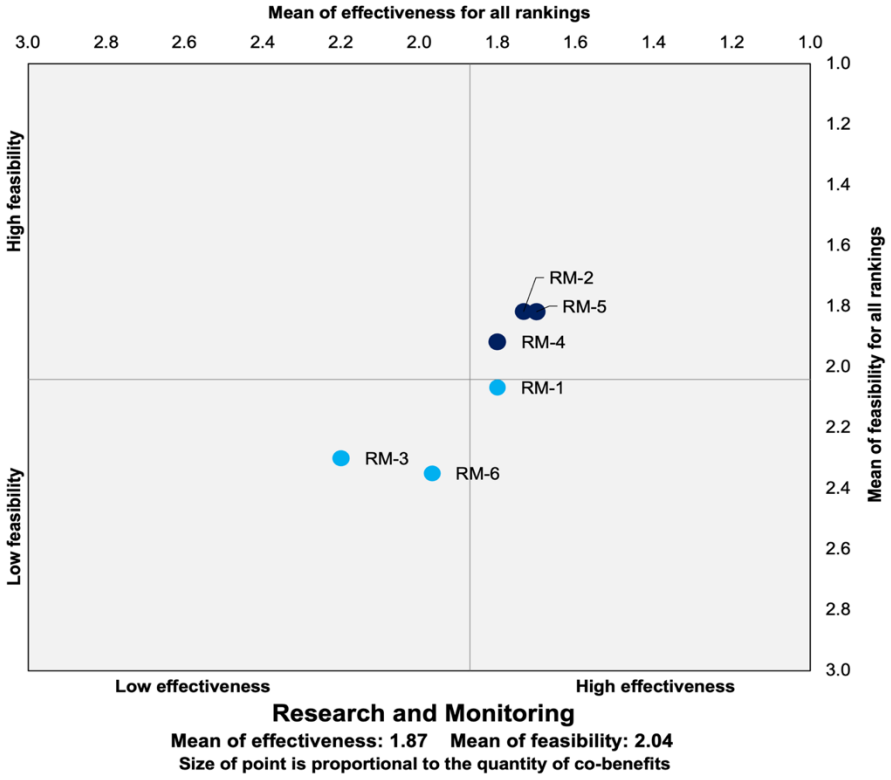
Six corridors management strategies related to Research and Monitoring were assessed by the expert panel (Table 8). None of these achieved high consensus as being highly effective. One strategy had high consensus as being highly effective to somewhat effective: implementing formal reporting mechanisms to elucidate and assess ship operators' compliance with the intentions and guidelines of the corridors. One strategy had medium consensus as being highly effective to somewhat effective: enhancing identification of marine protected areas within and along the corridors, in ways that capture the dynamism of those areas, during ship navigation season. Table 8 displays the Research and Monitoring management strategies grouped by point of agreement regarding their effectiveness and consensus. The co-benefits and timeframe for suggested implementation are also provided. The feasibility (i.e., affordability and implementability) (probably feasible, neutral, or probably not feasible), co-benefits (significant to some co-benefits exist, to some co-benefits exist) and timeframe for implementation (short to medium term, to medium to long term) points of agreement are also provided.

Table 8 Research and Monitoring management strategies

Research and Monitoring						
		Point of Agreement				
Suggested management strategy		Effectiveness	Effectiveness Consensus	Feasibility	Co-benefits	Timeframe
RM-1	Develop and use formal reporting mechanisms to understand and analyze the extent to which ship operators are compliant with the intentions and guidelines of the corridors (e.g. respecting requested speed limits, areas to avoid)	Highly effective to somewhat effective	High	Neutral	Some co-benefits exist	Medium term
RM-4	Better identify marine protected areas within or along the corridors during ship navigation season in a way that captures dynamic aspects of those areas	Highly effective to somewhat effective	Medium	Neutral	Some co-benefits exist	Medium to long term
RM-3	Use shore-based surveillance to understand the extent to which ship operators are compliant with the intentions and guidelines of the corridors (e.g. respecting requested speed limits, areas to avoid)	Somewhat effective	High	Neutral	Significant to some co-benefits exist	Medium to long term
RM-5	Annually analyze use of the corridors (by season) with input from communities in Inuit Nunangat, ship operators, and other experts where relevant	Somewhat effective	High	Neutral	Significant to some co-benefits exist	Short to medium term
RM-2	Conduct regular analysis of ship positions, using Automatic Identification System (AIS) or other, to understand the extent to which ship operators are compliant with the intentions and guidelines of the corridors (e.g. respecting requested speed limits, areas to avoid)	Somewhat effective	High	Neutral	Some co-benefits exist	Medium term
RM-6	Increase ocean instrumentation along the corridors to enable scientific initiatives	Somewhat effective	High	Neutral	Some co-benefits exist	Medium to long term

3.3.10 EFFECTIVENESS-FEASIBILITY PLOT FOR RESEARCH AND MONITORING STRATEGIES

Figure 10 displays the effectiveness-feasibility plot for strategies in the Research and Monitoring theme. Three grouped strategies with significant co-benefits are in Quadrant A (high effectiveness and high feasibility), which indicates they are potential areas for focus of governance efforts. These include using Automatic Identification System (AIS) to measure ship compliance (RM-2), enhancing identification of marine protected areas within and along the corridors, in ways that capture the dynamism of those areas, during ship navigation season (RM-4), and including input from rights holders and stakeholders in annual corridors-use analyses (RM-5). One strategy with significant co-benefits is in Quadrant B (high effectiveness and low feasibility), however it sits near the line between categories thus needs further investigation to see if there is reason to move it into Quadrant A. This strategy, RM-1, is to develop formal reporting mechanisms to explore and assess ship operators' compliance with the intentions and guidelines of the corridors. The remaining strategies, using shore-based surveillance to monitor ship operator compliance (RM-3), and increasing ocean instrumentation to enable scientific initiatives (RM-6), are in Quadrant C (low effectiveness and low feasibility), suggesting they should not be the focus of governance efforts.



Legend	
RM-2	Conduct regular analysis of ship positions, using Automatic Identification System (AIS) or other, to understand the extent to which ship operators are compliant with the intentions and guidelines of the corridors (e.g. respecting requested speed limits, areas to avoid, etc.)
RM-4	Better identify marine protected areas within or along the corridors during ship navigation season in a way that captures dynamic aspects of those areas
RM-5	Annually analyze use of the corridors (by season) with input from communities in Inuit Nunangat, ship operators, and other experts where relevant

Figure 10 Effectiveness-feasibility for Research and Monitoring management strategies

3.4 RANKING OF MANAGEMENT STRATEGIES

An additional step was taken in the analysis of the survey results to rank all the strategies, regardless of themes. To do this, a single score for feasibility was determined by summing the affordability and ease of implementation scores. Consideration was then given to the level of consensus among respondents, whereby low-consensus items were lower in effectiveness compared to higher-consensus recommendations.

3.4.1 HIGHEST-RANKED MANAGEMENT STRATEGIES

Using respondents' ratings of each individual management strategy (e.g., highly effective, somewhat effective, limited effectiveness, not effective as outlined in Table 1) the 45 management strategies were ranked in terms of their effectiveness and feasibility (i.e., affordability and implementability). This was done by 1) determining the final point of agreement (i.e., the rating most often selected by respondents) for effectiveness and for feasibility; 2) assigning each strategy a 'score' between 1 and 8 based on the points of agreement for effectiveness and feasibility (Table 9); and 3) sorting the scores first by effectiveness, and then by feasibility.

Table 9 The scoring process whereby points of agreement were determined

Value/Score*	Effectiveness	Feasibility
1	Highly effective	Definitely feasible
1.5	Highly effective to somewhat effective	Probably feasible
2	Somewhat effective	Probably feasible
2.5	Somewhat effective to limited effectiveness	Probably feasible
3	Limited effectiveness	Probably feasible
3.5	Limited effectiveness to not effective	Probably feasible
4	Not effective	Neutral
4.5		Neutral
5		Neutral
5.5		Probably not feasible
6		Probably not feasible
6.5		Probably not feasible
7		Probably not feasible
7.5		Definitely not feasible
8		Definitely not feasible

* Feasibility was assigned a score between 1 and 8 because it is the total of affordability and implementability, whereas effectiveness was assigned a score between 1 to 4 as in the survey Likert scale (Table 1).

The 'first order priority strategies' included 10 strategies ranked 'highly effective' or 'highly effective to somewhat effective', and ranging from 'probably feasible', to 'neutral' (Table 10). The ten highest ranked strategies spanned three of the five themes: Knowledge Mobilization and Communication, Resources and Services, and Culture and Environment. The timescale that the expert panel recommended for implementing each strategy, along with the pCresence or absence of co-benefits are displayed. There were 35 management

strategies ranked as ‘second order priority strategies’, ranging from ‘somewhat effective’ to ‘somewhat effective to limited effectiveness’, and from ‘probably feasible’ to ‘neutral’ (see Appendix B for the complete list of ranked management strategies).

Table 10 Highest Ranked Corridors Management Strategies

Highest Ranked Management Strategies						
			Point of Agreement			
Suggested management strategy		Effectiveness	Effectiveness Consensus	Feasibility	Timeframe	Co-benefits
KMC-3	Establish a single point of contact that Inuit Nunangat community members can connect with if they observe non-compliance of regulations	Highly effective	High	Probably feasible	Short term	Significant co-benefits exist
KMC-6	Provide freely available and easy to access digital maps of the corridors (including significant areas, and Inuit-identified recommendations for operation (e.g., slow zones, no-anchor zones) to all operators for their consideration during pre-trip planning and for real-time navigational decisions	Highly effective	High	Probably feasible	Medium term	Significant co-benefits exist
RS-1	Establish a public website for corridors that acts as a 'one stop shop' for information on corridor use, shipping trends, impacts, significant areas (ecologically and culturally), best practices, suggested routes, areas to avoid, pollution restrictions, fuel requirements, notices to mariners, voyage planning, bulletins, information on Inuit Nunangat communities etc.	Highly effective	High	Neutral	Medium term	Significant co-benefits exist

RS-11	Provide continual training for Inuit and northerners in Inuit Nunangat communities to use the fuel spill kits specifically placed along the corridors and clearly outline who is responsible for which kit	Highly effective	High	Neutral	Short to medium term	Significant co-benefits exist
RS-5	Invest in and modernize navigation aids throughout the entire corridors system	Highly effective	High	Neutral	Medium to long term	Significant to some co-benefits exist
RS-10	Invest in and establish a reliable and robust network of digital communications infrastructure to support the entire corridors system	Highly effective	High	Neutral	Medium to long term	Significant co-benefits exist
RS-6	Invest in and ensure modern charting exists throughout the entire corridors system and is maintained to the most modern standards available over time	Highly effective	High	Neutral	Medium to long term	Significant co-benefits exist
KMC-2	Create educational materials for communities in Inuit Nunangat to better understand ship operators' constraints and needs to ensure safe and sustainable practices	Highly effective to somewhat effective	Medium	Probably feasible	Short term	Significant to some co-benefits exist
KMC-5	Publicly share the names of vessels that regularly violate regulations in the corridors (i.e. so all ships are not blamed for poor decisions among a few)	Highly effective to somewhat effective	Medium	Probably feasible	Short term	Some to few co-benefits exist
CE-2	Key features in the corridors including Culturally Significant Marine Areas (CSMAs) and Ecologically and Biologically Significant Areas (EBSAs) will be regularly shared (including updates) with ship operators for consideration when navigating in the area.	Highly effective to somewhat effective	High	Probably feasible	Medium term	Significant to some co-benefits exist

3.5 CONSIDERATION OF DIVERGENCE IN OPINION OF EXPERT PANELISTS IN MANAGEMENT STRATEGY ANALYSIS

It is uncommon to reach full agreement on any management strategy, but it is imperative that a degree of consensus is reached. The final ranking of the full suite of corridors management strategies took into account the degree of consensus among expert panelists, which was generally high for first-order strategies, and lower for the remaining strategies (Appendix C). This finding suggests that expert panelists agreed as to which management strategies were the most likely to be effective and feasible, thus these strategies should be the focus of future consideration for implementation.

Figures 11 through 14 present the range of similarities and differences in points of agreement by expert panel member affiliation (i.e., government, Inuit organizations, industry, and others, such as NGOs, and academics). This analysis was conducted to determine whether there was any divergence of opinion among certain groups. There was strong consensus between groups on the point of agreement. In general, there are strong similarities on the point of agreement within groups (i.e., government employees tend to agree with government employees, Inuit organization representatives tend to agree with Inuit organization representatives) with the exception of industry representatives, which tended toward less agreement regarding the effectiveness of certain Governance and Regulation, and Resources and Services management strategies (Figures 11a and 11b). This finding suggests that overall, expert panel members agreed in their ranking of management strategies, regardless of their affiliation. Appendix C shows the level to which stakeholder groups agreed with each other on the items ranked as lower priority items (n=35).

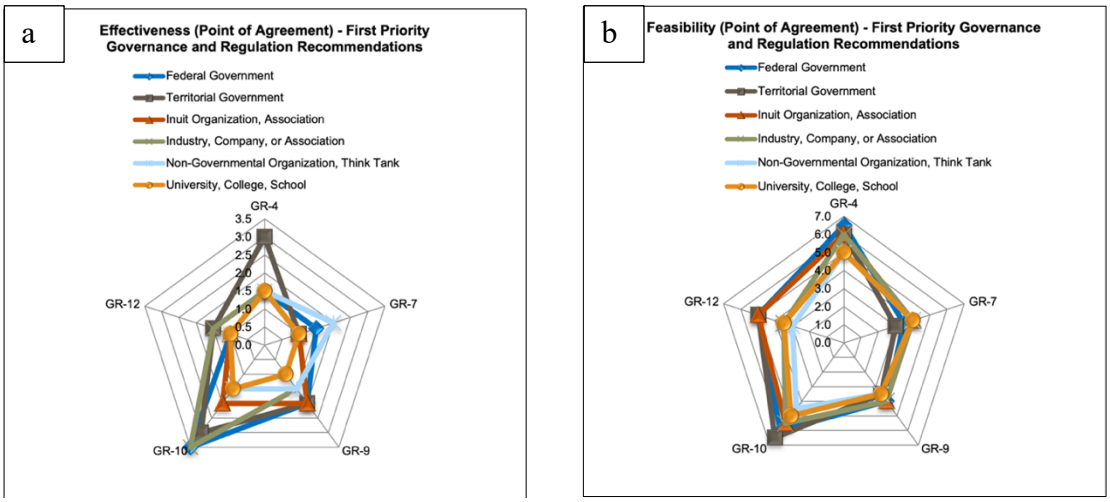


Figure 11 Point of agreement among expert panel members on (a) effectiveness and (b) feasibility of first priority Governance and Regulation management strategies

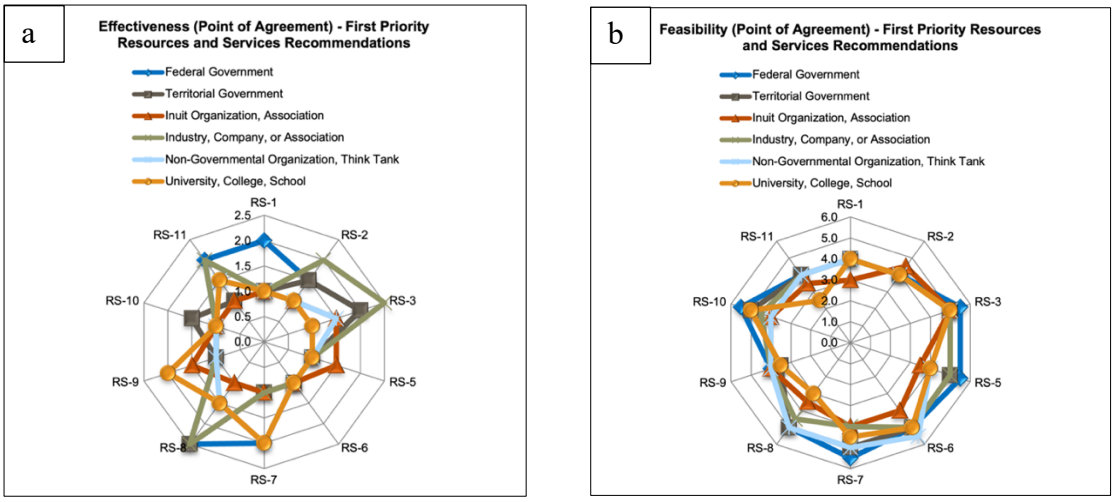


Figure 12 Point of agreement among expert panel members on (a) effectiveness and (b) feasibility of first priority Resources and Services management strategies

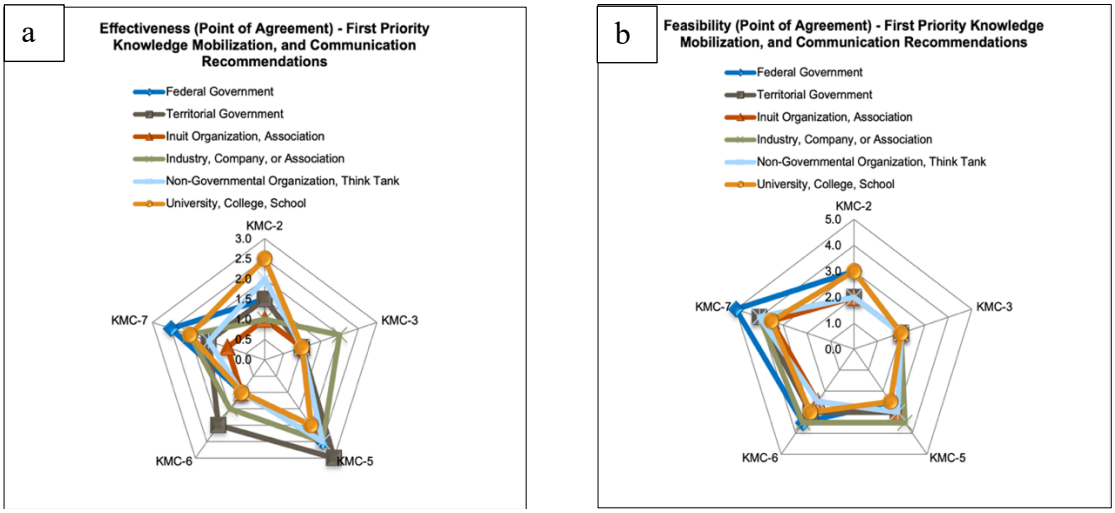


Figure 13 Point of agreement among expert panel members on (a) effectiveness and (b) feasibility of first priority Knowledge Mobilization and Communication management strategies

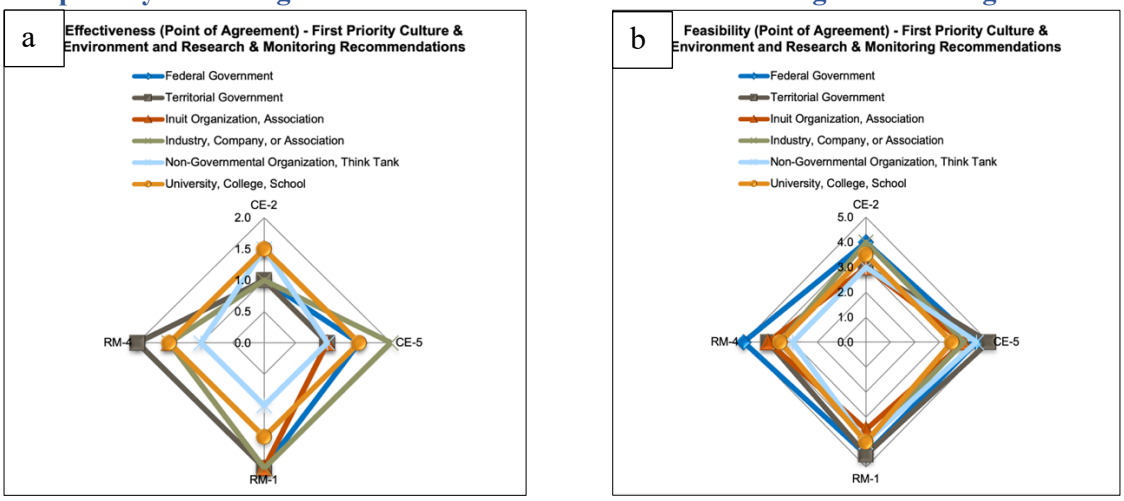


Figure 14 Point of agreement among expert panel members on (a) effectiveness and (b) feasibility of first priority Culture and Environment, and Research and Monitoring management strategies

3.6 GUIDING PRINCIPLES FOR MANAGEMENT STRATEGY IMPLEMENTATION

During the convergence phase (Section 2.2), thematic coding and evaluation of the respondent-identified management strategies revealed two overarching themes/patterns/ideas that underpinned all management strategies and served as a foundation to guide implementation efforts. We present these two themes as principles to guide management strategy implementation (Figure 15).

The first guiding principle is that the corridors should be managed **responsively** and **inclusively** i.e., by

- Including Inuit at all stages of decision-making;
- Making Inuit community priorities and perspectives the basis of the corridors concept;
- Giving Indigenous knowledge and western scientific methods equal consideration;
- Benefitting and meeting the needs of Inuit; and
- Providing essential services to ships and their crews.

The second guiding principle identified by survey round one respondents is that the corridors should be managed **dynamically** i.e., by

- Incorporating both the feedback of impact Indigenous communities and federal government-sourced;
- Infuse government-sourced information and the feedback of impacted Indigenous communities;
- Addressing seasonal activities and information needs (e.g., harvesting by Inuit, presence or absence of wildlife, changing ice and weather conditions);
- Communicating real-time information to ship crews and affected communities; and
- Enabling current and emerging priorities to be integrated into the corridors framework.

Figure 15 Guiding principles for corridors management strategy implementation

3.7 GOVERNANCE BODIES

A key goal of this corridors governance Policy Delphi was to establish a broad inventory of both novel and common governance bodies with the authority and required mechanisms for effective corridors governance. Survey round one and two participants identified a broad range of potential bodies for corridors governance: an Arctic shipping authority, and a variety of boards, commissions, and committees. Participants also outlined the roles and responsibilities of numerous rights holder and stakeholder groups in governance body decision-making (Table 11 and Appendix D). The governance bodies and stakeholder and rights holder groups described here could be part of a shared leadership approach to corridors governance. These respondent-identified suggestions may assist decision-makers in their own internal processes of determining who will be involved in corridors governance and in what capacity.

Table 11 Potential corridors governance bodies, with potential rights holder and stakeholder roles and responsibilities as identified by respondents

Governance Body	Description, roles, and responsibilities
Arctic shipping authority	• Comprising representatives from Indigenous communities and organizations, industry, territorial, federal, and academic representatives. • Shipping industry representatives to comment on rules and procedure development. • Some level of control over the corridors (perhaps through permitting). • Authority to rest with national and territorial governments.
Board of Directors*	• Comprising representatives from Indigenous communities and organizations, industry, territorial, and federal governments. • Each representative to have an equal say in decision-making i.e. an equal vote. • Decision-making would require consensus. • Shipping industry representatives to comment on rules and procedure development
Advisory Board**	• Federal government agencies would continue to control/govern shipping. • Any additional input would be advisory and from groups whose title does not convey any sense of authority over the application of federal mandates. • Shipping industry representatives to comment on rules and procedure development.
Commission***	• Established by the Canadian Coast Guard. • Co-chaired by Inuit and the federal government. • The permanent management body responsible for overseeing the system, targeting resources, supporting safe and responsible vessel traffic, monitoring performance, and adapting to change. • Develop the corridors and a vision for Canadian Arctic shipping. • Shipping industry representatives to comment on rules and procedure development.
Co-management Committee	• Comprising representatives from Indigenous communities and organizations, territorial, and federal governments.

	• Could involve an existing co-management committee but with expanded scope and focus (versus creating a new committee). • Ensure transparent decision-making processes and clear allocation of decision-making power, responsibilities, and tasks.
National level governance committee	• Comprising representatives from Indigenous communities and organizations, territorial governments, and all federal departments responsible for monitoring, enforcement, and policy development around shipping and low impact corridors. • With regional governance bodies, throughout Inuit Nunangat, as defined by comprehensive land claims agreements. • Collect Indigenous knowledge and scientific data to inform corridors placement and refinement. Formulate recommendations accordingly. Reach consensus on policy processes.
Oversight committee for each region in Inuit Nunangat	• Comprising representatives from Indigenous communities and organizations, territorial governments, and all federal departments responsible for monitoring, enforcement, and policy development around shipping and low impact shipping corridors. • Provide guidance and safety measures to abide by.
Working group committee	• Comprising representatives from Indigenous communities and organizations, territorial governments, and all federal departments responsible for monitoring, enforcement, and policy development around shipping and low impact shipping corridors. • Draft corridors policy, liaise with their home organizations.

***For the Board of Directors governance option** above, expert panel members identified several factors for consideration: A simple voting mechanism (e.g., as described for the Board of Directors) may marginalize Inuit and industry since they could be easily outvoted. Consensus may be impractical and can also give anyone effective veto power. The power dynamics involving a big industry, government agencies, and Inuit need to be considered carefully as would the proportions of representation by each party; for instance, if Indigenous representatives would equal in number those from industry and government. Expert panel members also raised questions for consideration: if decision-making is consensus based, what would happen in the case of a split vote; who would have veto power; and who would chair the board.*

***For the Advisory Board governance option** above an expert panelist noted that this structure would undermine many of the principles and strengthens of the initiative.*

****For the Commission governance option** above, an expert panelist noted that any commission should equally involve Transport Canada since they are the regulatory authority that can potentially make future legislative changes to support corridors implementation.*

In addition to identifying potential governance bodies, and roles and responsibilities of rights holders and stakeholders (Table 11), respondents articulated several factors for consideration during the selection and implementation of a corridors-governance body:

1. Care should be taken not to simply layer on bureaucracy, or dilute voices across the north;
2. Canada is signatory to many international shipping, navigational, and safety agreements that place control of corridors governance in the hands of appropriate federal government agencies. While exercising this mandate it would be prudent of these agencies to include Inuit knowledge. It remains unknown whether the international community would accept an abrogation of current federal responsibility to local rights holder groups;
3. Transport Canada represents Canada at the International Maritime Organization (IMO) and should be the lead agency in Canada. The Canadian Coast Guard, as an operational agency, can assist in

the establishment of the practical navigation rules and regulations. Consultations with regional Indigenous leaders is crucial;

4. It is important to differentiate between those who hold Rights and Authority (Canada, Inuit) and other actors. For the corridors to be strong, they should be considered an expression of rights and authority, and therefore co-governed by Inuit and the federal (and territorial/provincial, as appropriate) governments; and
5. Regarding decision-making and advice, existing structures and mechanisms that facilitate requests to boards, and that are established under land claims, should be utilized as appropriate.

4.0 CONCLUSION

Ship traffic has increased significantly in the Canadian Arctic over the past three decades and additional growth is expected as climate change continues to increase navigability in the region. In response, a corridors working group comprising representatives from the Canadian Coast Guard, Transport Canada, and the Canadian Hydrographic Service are co-developing 'Low Impact Shipping Corridors' as an adaptation strategy and are investigating governance options. The intended goals of the Policy Delphi approach presented here were to 1) Advance the conversation about Inuit and Northern involvement in corridors management, including legal imperatives and political considerations; 2) Bring together a wide range of participants for the discussion of Inuit and Northern involvement in a governance structure for the corridors; and 3) Identify and evaluate governance and management options for the corridors that include Inuit and Northerners.

To establish a comprehensive set of recommended corridors management strategies and governance bodies it was important to involve a diverse group of people, selected for their expertise, to interact on the issue of corridors governance, and consider the level of consensus among rights holders and stakeholders in their ranking of suggested strategies. One important advantage of the method was the inclusion of senior decision-makers in the evaluation of potential approaches for corridors governance. Such persons are positioned to implement the recommendations identified through this exercise. The entire process involved iteratively consulting with a variety of rights holders and stakeholders to ensure that the recommendations created were legitimate and dependable.

Further investigation regarding how each management strategy will be implemented and operationalized will need to be conducted by relevant agencies and organizations before implementation. It may be prudent for all of the management strategies and governance bodies presented here, and not only those that ranked highest, to be considered and assessed based on additional factors not included here (e.g., available funds and resources, political will, evolving mandates). Rights holder and stakeholder experts working directly on corridors management and governance are ideally positioned to decide upon the details associated with implementation and how these management strategies and governance bodies might be operationalized.

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APPENDIX A: SURVEY RESPONDENTS

Survey respondents (rounds one and two) are listed here in alphabetical order with affiliations indicated according to each respondent's preference. Expert panel members (survey round three) are indicated with*. An additional 18 and 15 round one and two respectively, respectively, as well as five expert panel members, requested anonymity.

Erin Abou-Abssi* (Oceans North)
Catherine Boyd (Government of Northwest Territories)
Kaitlin Breton-Honeyman
Dr. Lawson W. Brigham* (University of Alaska Fairbanks; Wilson Center Polar Institute)
Sebastian Charge* (Department of Economic Development and Transportation, Government of Nunavut)
Frederick Constantine (Woodward Group of Companies)
Andrew Dumbrille* (WWF-Canada)
Tess Forbes* (Inuvialuit Regional Corporation)
David Fowler* (Fowler Marine Inc.)
Michelle Gruben
William Halliday* (Wildlife Conservation Society Canada)
Captain Laurie Hatfield
Henry Huntington* (Ocean Conservancy)
Janelle Kennedy* (Nunavik Marine Region Planning Commission)
Jacqueline Kidd*
Peter Kikkert (St. Francis Xavier University)
Chris King (Desgagnés)
Pat Klengenberg (Inuvialuit Game Council)
P. Whitney Lackenbauer* (Trent University, Canada)
Suzanne Lalonde* (Université de Montréal)
Frédéric Lasserre* (Laval University)

Ann Eileen Lennert (The Association of Arctic Expedition Cruise Operators
Craig Lingard* (Kativik Regional Government, Civil Security Department)
Ian Marr* (Master Mariners of Canada)
Darren Locke
Andrew McNeill*
Olivia Mussels* (Oceans North)
Melissa Nacke
John Noksana Jr. (Fisheries Joint Management Committee)
Neil O'Rourke
Annika Ogilvie* (Fednav)
Andrew Orawiec
Tommy Palliser (Nunavik Marine Region Wildlife Board)
Raymond Pierce
Tyrone Raddi
John Noksana Jr. (Fisheries Joint Management Committee)
Kyle Ritchie* (Nunavut Wildlife Management Board)
Captain Marc S. Rothwell (Canadian Coast Guard - Retired)
Captain David (Duke) Snider* (Martech Polar Consulting Ltd.)
Cedar Swan* (Adventure Canada)
Daniel Taukie (Nunavut Tunngavik Incorporated)
Mark Thompson (Government of Nunavut)
Jilani Zarrouk (Desgagnés Transarctik)

APPENDIX B: RANKING OF ALL MANAGEMENT STRATEGIES

Table 12 Ranked Management Strategies for Corridors

Ranked Management Strategies						
		Effectiveness				
Suggested management strategy		Point of Agreement	Consensus	Feasibility	Timeframe	Co-benefits
KMC-3	Establish a single point of contact that Inuit Nunangat community members can connect with if they observe non-compliance of regulations	Highly effective	High	Probably feasible	Short term	Significant co-benefits exist
KMC-6	Provide freely available and easy to access digital maps of the corridors (including significant areas, and Inuit-identified recommendations for operation (e.g. slow zones, no-anchor zones) to all operators for their consideration during pre-trip planning and for real-time navigational decisions	Highly effective	High	Probably feasible	Medium term	Significant co-benefits exist
RS-1	Establish a public website for corridors that acts as a 'one stop shop' for information on corridor use, shipping trends, impacts, significant areas (ecologically and culturally), best practices, suggested routes, areas to avoid, pollution restrictions, fuel requirements, notices to mariners, voyage planning, bulletins, information on Inuit Nunangat communities etc.	Highly effective	High	Neutral	Medium term	Significant co-benefits exist
RS-11	Provide continual training for Inuit and northerners in Inuit Nunangat communities to use the fuel spill kits specifically placed along the corridors and clearly outline who is responsible for which kit	Highly effective	High	Neutral	Short to medium term	Significant co-benefits exist
RS-5	Invest in and modernize navigation aids throughout the entire corridors system	Highly effective	High	Neutral	Medium to long term	Significant to some co-benefits exist

RS-10	Invest in and establish a reliable and robust network of digital communications infrastructure to support the entire corridors system	Highly effective	High	Neutral	Medium to long term	Significant co-benefits exist
RS-6	Invest in and ensure modern charting exists throughout the entire corridors system and is maintained to the most modern standards available over time	Highly effective	High	Neutral	Medium to long term	Significant co-benefits exist
KMC-2	Create educational materials for communities in Inuit Nunangat to better understand ship operators' constraints and needs to ensure safe and sustainable practices	Highly effective to somewhat effective	Medium	Probably feasible	Short term	Significant to some co-benefits exist
KMC-5	Publicly share the names of vessels that regularly violate regulations in the corridors (i.e. so all ships are not blamed for poor decisions among a few)	Highly effective to somewhat effective	Medium	Probably feasible	Short term	Some to few co-benefits exist
CE-2	Key features in the corridors including Culturally Significant Marine Areas (CSMAs) and Ecologically and Biologically Significant Areas (EBSAs) will be regularly shared (including updates) with ship operators for consideration when navigating in the area.	Highly effective to somewhat effective	High	Probably feasible	Medium term	Significant to some co-benefits exist
GR-7	Create an official national corridors working group/committee (with regional representation) that includes federal and territorial governments, Inuit, and ship operators	Highly effective to somewhat effective	High	Neutral	Medium term	Significant co-benefits exist
GR-9	Create corridors task teams / sub-committees to focus on specific needs such as, identification of charting needs, pilotage needs, vessel traffic services (VTS), navigational needs, infrastructure needs, search and rescue (SAR) needs and others	Highly effective to somewhat effective	High	Neutral	Short to medium term	Significant co-benefits exist

GR-12	Use of the corridors will be mandatory unless there is a clear safety reason not to use them	Highly effective to somewhat effective	Medium	Neutral	Medium term	Significant to some co-benefits exist
RS-2	Invest in a system that provides all coastal communities in Inuit Nunangat with real-time access to satellite-based Automatic Identification System (AIS) real-time ship movement data that enables locally based ship monitoring	Highly effective to somewhat effective	High	Neutral	Medium term	Significant to some co-benefits exist
RS-7	Invest in extensive weather instrumentation that is on par with other Canadian regions along the corridors to enable better environmental forecasting	Highly effective to somewhat effective	High	Neutral	Medium to long term	Significant co-benefits exist
RS-9	Establish and offer free access to voyage planning tools (including access to state of the art environmental forecasting data) for ship operators using the corridors	Highly effective to somewhat effective	High	Neutral	Medium term	Some co-benefits exist
KMC-7	Employ Inuit in each settled land claim region year-round to answer community questions about shipping, monitor AIS and traffic trends, update local perspectives, map culturally significant marine areas (CSMAs), communicate with ship operators when needed, etc.	Highly effective to somewhat effective	High	Neutral	Short to medium term	Significant co-benefits exist
RM-1	Develop and use formal reporting mechanisms to understand and analyze the extent to which ship operators are compliant with the intentions and guidelines of the corridors (e.g. respecting requested speed limits, areas to avoid, etc)	Highly effective to somewhat effective	High	Neutral	Medium term	Some co-benefits exist
RM-4	Better identify marine protected areas within or along the corridors during ship navigation season in a way that captures dynamic aspects of those areas	Highly effective to somewhat effective	Medium	Neutral	Medium to long term	Some co-benefits exist

GR-10	Increase local authorities' power so they can deal with non-compliance by ship operators within the corridors framework	Highly effective to somewhat effective	Low	Neutral	Medium to long term	Significant to some co-benefits exist
RS-8	Create new funding models (including wages for deployments) for the Coast Guard Auxiliary's new Arctic chapter that allows units to pre-deploy along the Corridor during busy periods	Highly effective to somewhat effective	Medium	Neutral	Medium term	Significant co-benefits exist
CE-5	Establish a reliable system for sharing real-time information on marine mammal locations as well as ongoing hunting and harvesting activities by Inuit hunters to ship operators so operators can avoid these areas when possible	Highly effective to somewhat effective	High	Neutral	Medium to long term	Significant co-benefits exist
RS-3	Invest in a system of shore-based AIS stations with provisions for regular maintenance and technical support to enable real-time monitoring of ship movements	Highly effective to somewhat effective	Medium	Neutral	Medium to long term	Significant to some co-benefits exist
GR-4	Establish and implement an Arctic pilotage authority in/for the Canadian Arctic	Highly effective to somewhat effective	Medium	Probably not feasible	Medium to long term	Some to few co-benefits exist
KMC-1	Include Inuit and community perspectives on ship operations at the northern Canadian Marine Advisory Council (CMAC) annual meetings as a standing topic for discussion and inclusion	Somewhat effective	High	Probably feasible	Short term	Significant co-benefits exist
GR-8	Instead of developing a national corridor working group/committee (see above), manage the corridors within institutional structures that already exist (i.e., to avoid bureaucracy)	Somewhat effective	Medium	Probably feasible	Short term	Some co-benefits exist
KMC-4	Improve public and international understanding of the objectives, role, and value of the corridors	Somewhat effective	High	Probably feasible	Short to medium term	Some co-benefits exist

GR-1	Develop official and publicly available corridors strategy and implementation plans that are dynamic and regularly evaluated	Somewhat effective	High	Probably feasible	Medium term	Some co-benefits exist
GR-2	Corridors placement will be dynamic (not static) and regularly updated based on stakeholder (ship operators) and rights holder (Indigenous groups) feedback	Somewhat effective	High	Probably feasible	Medium to long term	Significant co-benefits exist
GR-3	The impacts of marine shipping on Arctic communities will be evaluated annually	Somewhat effective	High	Neutral	Medium term	Significant co-benefits exist
GR-6	Corridors will be co-managed among relevant federal government agencies and the Regional Inuit Organizations (RIO)	Somewhat effective	High	Neutral	Medium to long term	Significant co-benefits exist
GR-14	Incorporate Proactive Vessel Management initiative (PVM) into the corridors framework	Somewhat effective	High	Neutral	Short to medium term	Significant to some co-benefits exist
GR-15	Incorporate Enhanced Maritime Situational Awareness initiative (EMSA) into the corridors framework	Somewhat effective	High	Neutral	Short to medium term	Significant to some co-benefits exist
KMC-8	Establish a compliance-certification program for the corridors based on the principals and success of the Marine Stewardship Council (MSC) certification for sustainable fisheries	Somewhat effective	High	Neutral	Medium to long term	Some co-benefits exist
CE-1	Develop an official set of 'Culturally Significant Marine Areas' (CSMAs) by utilizing and extending existing research and government initiatives	Somewhat effective	High	Neutral	Medium term	Significant to some co-benefits exist
RM-2	Conduct regular analysis of ship positions, using Automatic Identification System (AIS) or other, to understand the extent to which ship operators are compliant with the intentions and guidelines of the corridors (e.g. respecting requested speed limits, areas to avoid, etc)	Somewhat effective	High	Neutral	Medium term	Some co-benefits exist

RM-5	Annually analyze use of the corridors (by season) with input from communities in Inuit Nunangat, ship operators, and other experts where relevant	Somewhat effective	High	Neutral	Short to medium term	Significant to some co-benefits exist
RS-4	Expand the Inuit Marine Monitoring Program to cover the entire corridors system	Somewhat effective	High	Neutral	Medium to long term	Significant co-benefits exist
CE-4	Create a corridors environmental protection fund that can be accessed for local initiatives (research, monitoring, other programs)	Somewhat effective	High	Neutral	Medium to long term	Significant to some co-benefits exist
RM-3	Use shore-based surveillance to understand the extent to which ship operators are compliant with the intentions and guidelines of the corridors (e.g., respecting requested speed limits, areas to avoid)	Somewhat effective	High	Neutral	Medium to long term	Significant to some co-benefits exist
RM-6	Increase ocean instrumentation along the corridors to enable scientific initiatives	Somewhat effective	High	Neutral	Medium to long term	Some co-benefits exist
GR-11	Corridors will remain completely voluntary and will not be used to 'restrict' ship operations, activities, or movements	Somewhat effective to limited effectiveness	High	Probably feasible	Short term	Some to few co-benefits exist
GR-13	No new regulatory policies will be created to support corridors management /governance (i.e. existing mechanisms are sufficient)	Somewhat effective to limited effectiveness	Medium	Probably feasible	Short term	Some co-benefits exist
GR-5	Corridors will be co-managed among relevant federal government agencies and the national Inuit organization (Inuit Tapiriit Kanatami)	Somewhat effective to limited effectiveness	Medium	Neutral	Medium to long term	Some co-benefits exist
CE-3	Create an environmental protection committee for the corridors that includes stakeholders and rightsholders	Somewhat effective to limited effectiveness	Medium	Neutral	Medium term	Significant to some co-benefits exist

APPENDIX C: POINT OF AGREEMENT AMONG RESPONDENTS FOR EFFECTIVENSS AND FEASIBILITY ASSESSMENT OF 'OTHER PRIORITY' RECOMMENDATIONS

Figures 16 and 17 below present the level to which groups agreed with each other on strategies ranked as second-, third-, or no-priority items. There was lower consensus in general among expert panel members on second- and lower-priority items. This suggests they did not agree on which strategies should be considered for implementation. The lack of consensus could suggest that these strategies bear further investigation to determine their potential efficacy in corridors management or should not be considered for implementation.

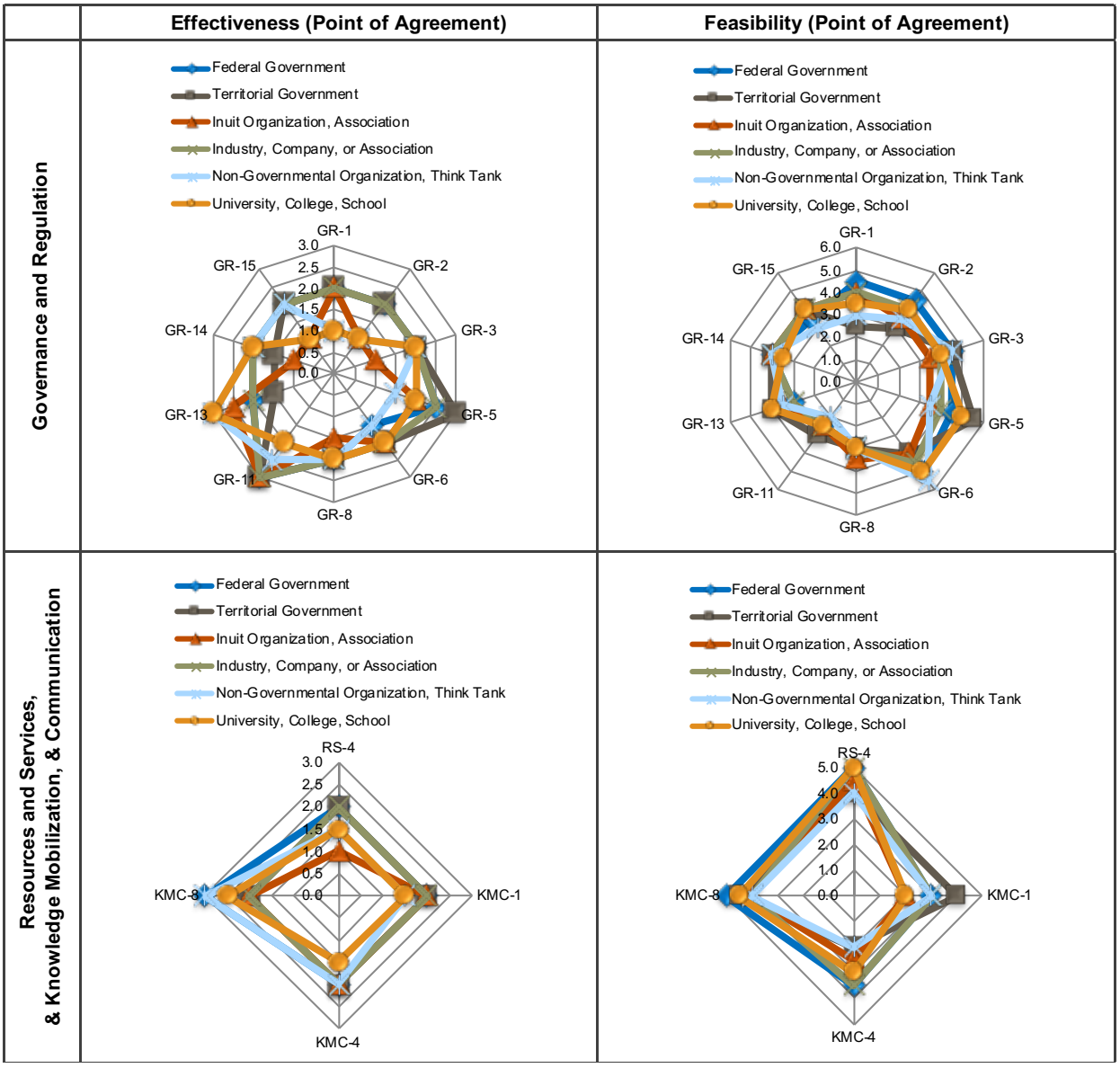


Figure 16 Point of agreement among expert panel members on (left) effectiveness and (right) feasibility of other priority Governance and Regulation, Resources and Services, and Knowledge Mobilization and Communication management strategies

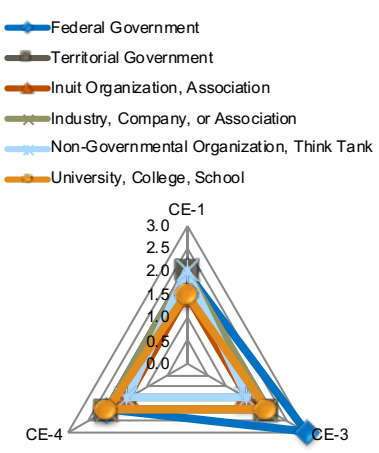
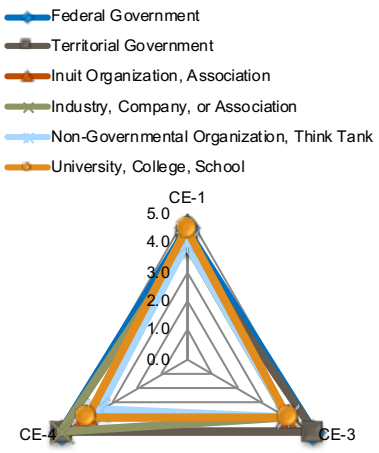
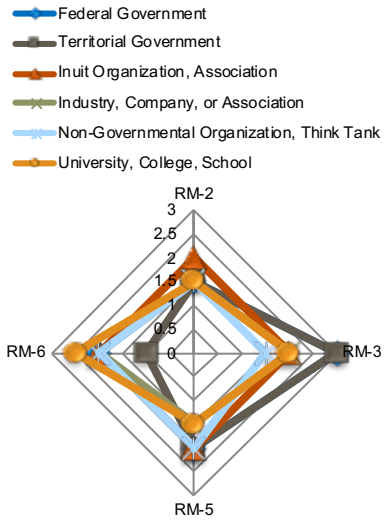
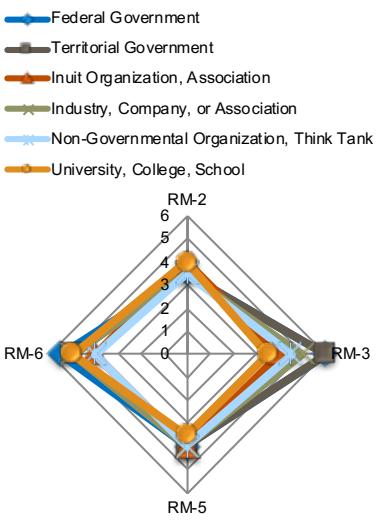
	Effectiveness (Point of Agreement)	Feasibility (Point of Agreement)
Culture and Environment		
Research and Monitoring		

Figure 17 Point of agreement among expert panel members on (left) effectiveness and (right) feasibility of other priority Culture and Environment, and Research and Monitoring management strategies

APPENDIX D: RESPONDENT-IDENTIFIED ROLES AND RESPONSIBILITIES OF RIGHTS HOLDERS AND STAKEHOLDERS IN CORRIDORS GOVERNANCE

A key goal of this corridors governance Policy Delphi was to establish a broad inventory of the roles and responsibilities of numerous rights holder and stakeholder groups in governance body decision-making. The governance bodies and stakeholder and rights holder groups described bear consideration in the development of a shared leadership approach to corridors governance. Respondents identified numerous Inuit Nunangat-based organizations and federal agencies with potential roles and responsibilities in corridors governance.

D.1 RESPONDENT-IDENTIFIED ROLES OF INUIT NUNANGAT-BASED ORGANIZATIONS IN CORRIDORS GOVERNANCE

Respondents identified numerous organizations in Inuit Nunangat to be involved in corridors governance and outlined roles and responsibilities. These include:

1. **Land Claim Organizations, Institutions of Public Government, Regional Inuit Associations, Territorial Governments, Co-management Boards, Hunters and Trappers Organizations/Association/Committees and Local Nunavimmi Umajutvijiit Katajuaqatigininga (LNUK i.e., local hunters, fishermen and trappers association in Nunavik)** to be directly involved in corridors governance.

2. **Land Claim Organizations and Territorial Governments** to co-lead corridors governance with the Government of Canada.

3. **Land Claim Organizations, Institutions and Public Government, Regional Inuit Associations and Co-management Boards** would, with Government of Canada, determine
   - corridors management decision-making processes;
   - corridors location;
   - parameters required for corridors to be ‘low-impact’;
   - infrastructure investment requirements;
   - corridor implementation employment opportunities; and
   - how to protect community travel routes within corridors.

4. **Territorial Governments** would:
   - Coordinate their emergency management division with search and rescue and play a prominent role in day-to-day decision making and emergency operations;
   - Contribute to policy development, operational protocols, and collection of data to inform decision-making;
   - Advise on corridors placement to account for sensitive cultural and ecological areas, while maintaining safe routes for large vessels; and
   - Create stewardship and monitoring programs led by Inuit.

D.2 RESPONDENT-IDENTIFIED ROLES OF FEDERAL GOVERNMENT AGENCIES IN CORRIDORS GOVERNANCE

Respondents also identified numerous federal agencies to be involved in corridors governance and outlined potential associated roles and responsibilities for the agencies in corridors governance. The most frequently mentioned included the Canadian Coast Guard, the Canadian Hydrographic Service, Canadian Ice Service,

Environment and Climate Change Canada, Transport Canada, and Crown Indigenous Relations and Northern Affairs Canada (Table 12). Less frequently mentioned agencies included Department of National Defence, Royal Canadian Navy, Royal Canadian Mounted Police, Global Affairs Canada, Public Safety Canada, Industry Canada, Fisheries and Oceans Canada, NORDREG personnel, Federal law enforcement agencies, and Parks Canada.

Table 13 Respondent-identified potential federal government agency roles and responsibilities in corridors governance

	Agency				
Role	Canadian Coast Guard	Transport Canada	Canadian Hydrographic Service	Environment and Climate Change Canada	Crown-Indigenous Relations and Northern Affairs Canada
Operation protocol	X	X	X	X	X
Play a prominent role in emergency and day-to-day operations	X	X	X	X	X
Collection of data to support decisions*		X	X	X	X
Directly involved in governance	X	X	X	X	
Cooperating with industry and tourism	X	X		X	
Distributing corridors to industry and tourism, and at encouraging their use at conferences	X	X		X	
Publish the corridors with other products (i.e., ice charts)	X	X		X	
Operations to encourage industry and tourism to assess their planned routes in accordance with the corridors	X	X	X		
Provide guidance, leadership, and subject matter expertise. Provide insight necessary for objective planning and development of requirements to enable safe and environmentally "friendly" shipping while not hindering vessel routing and operation	X	X		X	
Expand the corridors	X		X		
Conduct monitoring	X	X			
Enforce regulations and be a Canadian presence on the water	X				
Provide Vessel Traffic Services, aids to navigation, icebreaking services, environmental response, and marine search and rescue	X				
Prioritize the corridors			X		

Provide charts and publications for safe navigation, tides and currents information			X		
Responsible for marine protected areas				X	
Corridors administration and set regulations		X			
Enforce the Arctic Shipping Safety and Pollution Prevention Regulations (ASSPPR) and Arctic Waters Pollution Prevention Act (AWPPA)		X			

*The potential involvement of the Canadian Ice Service was also noted by respondents, in addition to providing sea ice information.