Identifying Potential Gaps in U.S. Coast Guard Arctic Capabilities

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HSOAC
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PREPARED FOR THE U.S. COAST GUARD

Preface

This report documents the outcome of a research project entitled "Department of Homeland Security [DHS] Evergreen Arctic Priorities," which focused on identifying priority potential Arctic capability gaps with respect to U.S. Coast Guard (USCG) operations in the region in 2017, and whether and how these gaps might become exacerbated by the 2030s. As the Arctic environment evolves, it is becoming increasingly important to determine how to operate in the region, given changing conditions and the potential for increasing activity that will drive demand for more-frequent U.S. government presence across a broader spectrum of roles. There are several challenges associated with operating in the Arctic, including large distances and the harsh environment, as well as limited infrastructure and available assets for communicating, observing, understanding, and maneuvering. This research provides an additional perspective on how to characterize potential gaps in order to develop clearer avenues ahead for mitigating them that cover a range of possible current and future USCG activities in the Arctic.

The primary purpose of this research is to support a USCG Capability Analysis Report focused on the Arctic. This report could be considered similar to a capability analysis and may be of broad interest to the USCG, DHS, and other decisionmakers involved with Arctic policy and planning.

This research was sponsored by the USCG Office of Emerging Policy and conducted within the Strategy, Policy, and Operations Program of the Homeland Security Operational Analysis Center, a federally funded research and development center (FFRDC).

About the Homeland Security Operational Analysis Center

The Homeland Security Act of 2002 (Section 305 of Public Law 107-296, as codified at 6 U.S.C. § 185), authorizes the Secretary of Homeland Security, acting through the Under Secretary for Science and Technology, to establish one or more FFRDCs to provide independent analysis of homeland security issues. The RAND Corporation operates the Homeland Security Operational Analysis Center (HSOAC) as an FFRDC for the Department of Homeland Security (DHS) under contract HSHQDC-16-D-00007.

The HSOAC FFRDC provides the government with independent and objective analyses and advice in core areas important to the Department in support of policy development, decisionmaking, alternative approaches, and new ideas on issues of significance. The HSOAC FFRDC also works with and supports other federal, state, local, tribal, and public- and private-sector organizations that make up the homeland security enterprise. The HSOAC FFRDC's research is undertaken by mutual consent with DHS and is organized as a set of discrete tasks.

This report presents the results of research and analysis conducted under HSHQDC-16-D-00007/HSCG23-17-J-M7P029.

The results presented in this report do not necessarily reflect official DHS opinion or policy.

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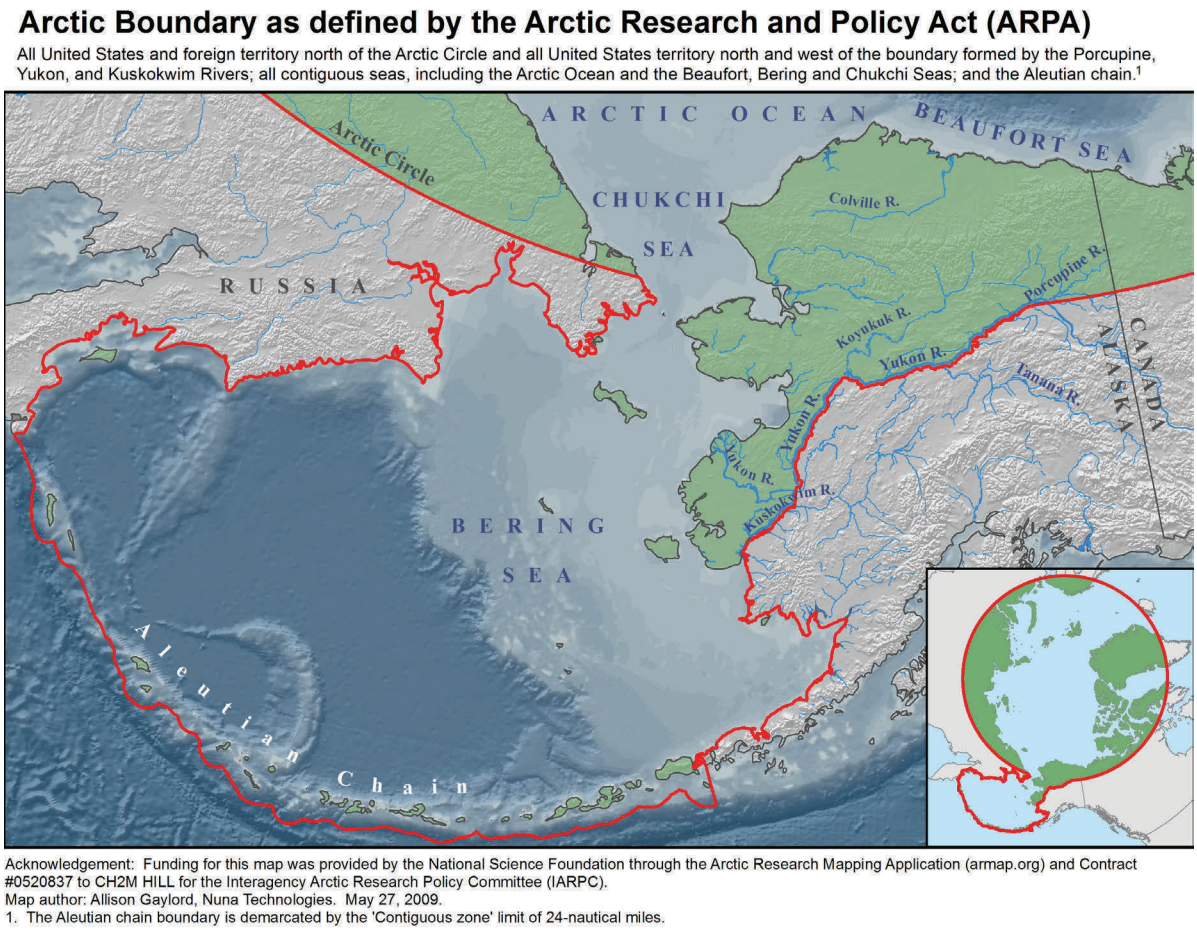
The Arctic Lies at the Intersection of Challenge and Opportunity

The U.S. Arctic covers a vast area (see Figure S.1) and is home to thousands of U.S. citizens with a rich cultural history. The Arctic is also of strategic importance to the United States because of Alaska's maritime border with northeastern Russia; the presence of the Bering Strait as a natural maritime chokepoint; and the role the region does or could play with respect to deterrence, global power projection, and air and missile defense. Changes in global temperatures are generally expected to continue making the Arctic Ocean more accessible (though still hazardous), whereas access to inland and coastal areas will be curtailed by thawing permafrost and erosion. There are multiple economic opportunities in the region, including further leveraging the region's natural resources (the Bering Sea fisheries, hydrocarbon deposits, and mineral reserves), developing the growing market for Arctic tourism, and using Arctic shipping routes.

Figure S.1. Map of the U.S. Arctic



SOURCE: U.S. Arctic Research Commission, "Arctic Boundary Map: Alaska with Polar Inset," webpage, undated.

Despite recently elevated temperatures in the Arctic, it remains an extreme operating environment with sparse infrastructure and equipment. The U.S. Coast Guard (USCG) already operates extensively in the rich fisheries of the Bering Sea while providing support to remote Arctic communities, enabling scientific research, and preparing to respond to possible contingencies. However, the USCG only has access to limited assets and personnel capable of safely and effectively operating in the Arctic. Increasing economic and other activity in the region over the next couple of decades will likely increase the demand for USCG and other U.S. Department of Homeland Security (DHS) operations in the region, including by the Federal Emergency Management Agency, Customs and Border Protection, the Transportation Security Administration, and the National Protection and Programs Directorate. Generally speaking, these other DHS components currently have less experience, fewer materiel assets, and fewer nonmateriel enablers to carry out successful Arctic operations than the USCG.

Multiple reports and statements have underscored the challenges of working in the Arctic today, capturing issues related to communications, awareness, access, and presence within the

region.[1] Despite persistent articulation of these concerns, however, identified Arctic gaps and challenges have in large part remained unresolved, although plans to replace an aging heavy icebreaker[2] constitute one of many needed steps in the right direction. The persistence of gaps inhibiting Arctic operations has put the USCG, DHS, and indeed the U.S. government as a whole at a distinct disadvantage for countering hazards and threats in the Arctic in 2017 and in the future.

Potential Gaps and Resulting Vulnerabilities

A key Arctic strategy and planning challenge for DHS and the USCG is how to enhance activities to prepare for operations before a crisis comes to pass. The USCG Arctic Strategy has been instrumental in developing some momentum for USCG and DHS planning in the region but may require updating in light of continuing transformations in the Arctic region.[3] Another important step in planning will involve the development of a new Arctic Capabilities Analysis Report (CAR), one type of planning document within the broader DHS Joint Requirements Integration Management System process. A CAR can help bring visibility to important challenges, as well as assist in initiating processes that bring about both materiel (e.g., development of new infrastructure) and nonmateriel (e.g., updates to strategy and plans) solutions. A well-constructed CAR relies on information detailing differences between the current state of capabilities and the desired future, and why these disparities are relevant for mission execution.

The research described in this report focuses on articulating potential Arctic capability gaps at the time of writing (2017) and in the 2030s.[4] It was designed to provide information for a forthcoming USCG Arctic CAR. As such, it includes some aspects of a capability analysis, such as the identification of necessary, high-level capabilities; articulation of links between

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[1] See Mead Treadwell, "U.S. Strategic Interests in the Age of an Accessible Arctic . . . What We Need to Know and Do Now," testimony for the U.S. Senate Committee on Appropriations, Subcommittee on Homeland Security, August 20, 2009; ABS Consulting, Potomac Wave Consulting, and Systems Planning and Analysis, Inc., "United States USCG High Latitude Region Mission Analysis Capstone Summary," July 2010; Arctic Domain Awareness Center, "Arctic-Related Incidents of National Significance Workshop on Maritime Mass Rescue Operations: Rapporteur's Report," September 6, 2016; Arctic Executive Steering Committee, *Appendix A: Implementation Framework for the National Strategy for the Arctic Region*, Washington, D.C., March 2016; Thad W. Allen, Christine Todd Whitman, Esther Brimmer, and Anya Schmemann, *Arctic Imperatives: Reinforcing U.S. Strategy of America's Fourth Coast*, New York: Council of Foreign Relations Press, March 2017.

[2] USCG Acquisition Directorate, "Polar Icebreaker: Program Overview," webpage, undated.

[3] USCG, *Arctic Strategy*, Washington, D.C., May 2013.

[4] Although the 2030s were the original focus, we also examined 2017 conditions to highlight both current capability and capacity limitations and the potential spectrum of USCG Arctic statutory missions by the 2030s.

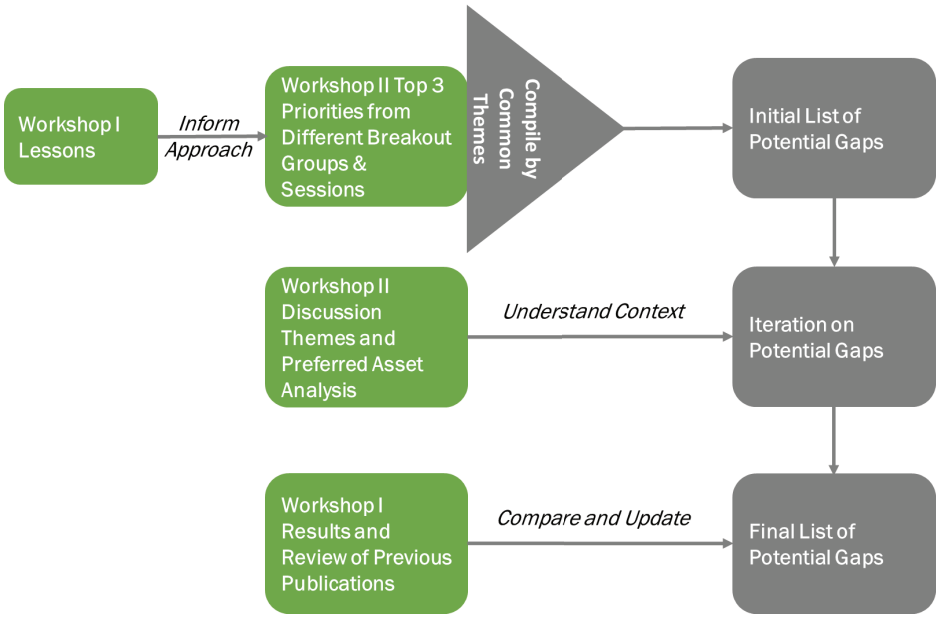
capabilities and missions; and documentation of potential capability gaps.[5] Although previous reports and statements have articulated Arctic needs, challenges, gaps, and vulnerabilities, this new work provides a fresh look at potential gaps using a structured, traceable approach that considers a broad spectrum of contingencies that DHS might have to respond to in the Arctic. It describes why each potential gap can affect mission execution in the Arctic and details current assets that can perform aspects of the capability associated with the gap. It also describes what future capabilities are needed, based on information derived from workshop-based evaluation of a large suite of new Arctic scenarios, the possible origins of each gap (i.e., is it linked to a capacity problem or something else), and some examples of possible avenues for mitigation. As such, it provides a tailored platform from which to launch CAR development.

Although we considered the content of previously published reports and statements in our analyses of facilitated expert workshop (including a diverse group of USCG, DHS, and other Arctic stakeholders) and logic model results, we deliberately designed our methods to test the continued relevance of previous findings,[6] identify any new areas for consideration, and articulate details about potential gaps relevant for a CAR. The research team used an iterative process to arrive at a list of potential Arctic capability gaps, as summarized in Figure S.2.

[5] In this report, *capabilities* are considered to be means of accomplishing particular ends, which might include objectives or missions; DHS, *Department of Homeland Security Manual for the Operation of the Joint Requirements Integration and Management System*, DHS Instruction Manual 107-01-001-01, April 4, 2016.

[6] ABS Consulting, Potomac Wave Consulting, and Systems Planning and Analysis, Inc., 2010; Arctic Domain Awareness Center, 2016; Charles Michel, "USCG Arctic Implementation Capabilities," testimony for U.S. House of Representatives Committee on Transportation and Infrastructure, Subcommittee on USCG and Maritime Transportation, July 12, 2016.

Figure S.2. Process for Identifying Potential Gaps



Key Findings

Through the process illustrated above, we arrived at three broad potential capability gaps, as well as a fourth gap having to do with how the USCG institutionally addresses operational gaps. In this section, we summarize these potential gaps, each with two or more subgaps, with a particular focus on what cannot consistently be done in the present that creates vulnerabilities or could generate vulnerabilities for conducting USCG statutory missions by the 2030s.[7] Note that the themes described here are not new ones; however, this articulation provides updated information and fresh insights that will help move discussions about Arctic needs forward, including through the development of a USCG Arctic CAR.

First, communications are critical to all missions, anywhere. In the Arctic, however, voice communications are patchy and unreliable, and transmission of data is extremely limited. Successful DHS execution of a range of mission types in the Arctic could require the ability to communicate via voice with partners anywhere at any time and transmit text, images, video, or other data more regularly.

Second, understanding and being able to assess situations is another important aspect of conducting a successful mission. However, multiple experts consulted for this work used the phrase "operating blind" with respect to the Arctic. Many threats and hazards in the region are poorly understood, and there is limited capacity or capability to regularly monitor those that are

[7] We define *vulnerabilities* as potentially causing detriment to human life, environmental quality, security, or economic potential.

identified. Persistent sensor coverage across the entire Arctic (including U.S. territory and key "seams" or transitions between U.S. and either international waters and airspace or other territories), particularly for previously unidentified threats and hazards that do not or cannot actively emit signals (e.g., "dark" vessels, fast-moving ice), is needed to enhance awareness. The ability to fuse information from individual data streams into a unified picture of activity and conditions is needed, along with a better understanding of whether existing sensors (regardless of the platforms that could carry them) are able to capture the full range of information about a diverse set of hazards and threats and how functionality is impacted by Arctic conditions.

Third, even if a threat or hazard has been identified and communicated about in the Arctic, the potential for doing anything about it is limited by the scarcity of available assets and supporting infrastructure, combined with long distances, harsh operating conditions, and the small scale of the resources available for coordination. Reducing the incidence of threats and hazards is a first step to reduce demand for response in the first place.[8] Once a response is needed, however, ensuring that the right people and assets are available and can be deployed rapidly will be key. A possible additional challenge includes having the materiel and procedures available to support all required response tasks, including medical care and hazardous material clean-up, and ensuring that there is sufficient persistence to sustain operations over an extended period.

Fourth, the USCG and DHS as a whole (along with a variety of partners) have had much difficulty in making progress toward addressing persistent Arctic challenges. Improving the USCG's capability as an institution to identify and articulate specific needs and risks could help generate momentum for closing Arctic (and other) capability gaps. Three factors are currently lacking that would help in this regard:

- the systematic identification and regular review of gaps, along with detailed potential remediation measures, using a repeatable process that encompasses a wide range of possible future demands
- documentation of the contributions that specific assets make toward enabling capabilities
- more fully illustrating the vulnerabilities or risks of not closing gaps, especially in quantitative terms, to provide concrete information that can aid in decisionmaking.

Implications for the USCG

We assess that the USCG currently has or could develop vulnerabilities across all 11 of its statutory missions in the Arctic because of the potential gaps identified above, based on information collected at structured workshops (as summarized in Table S.1). Using a qualitative rating scale, we assessed the level of vulnerability caused by each gap for each mission as *critical*, *important*, *potential*, or *minimal*. Distinctions between these categories were made on

[8] This subgap is related to the response gap as a whole because workshop participants saw reducing overall demand for response as an important component to a holistic approach for closing the response gap.

the basis of how relevant the mission was in the Arctic in 2017 or whether it might become important by the 2030s, along with the level of potential impact each gap could have on mission outcomes, including human life, security, economy, and the environment. Furthermore, this rating scale also considers what level of capability currently available materiel assets and nonmateriel enablers are able to provide.[9]

Table S.1. Level of Vulnerability Associated with Not Closing Possible Capability Gaps by the 2030s

Mission Category	Mission	Communications	Awareness	Response	Needs and Risks
Safety	Search and rescue	**Critical**	**Critical**	**Critical**	**Critical**
	Marine safety	**Critical**	**Critical**	**Critical**	**Critical**
Security	Ports, waterways, and coastal safety	Important	Important	**Critical**	**Critical**
	Drug interdiction	Potential	Potential	Potential	Important
	Migrant interdiction	Potential	Potential	Potential	Important
	Defense readiness	Important	Potential	Important	Important
Stewardship	Aids to navigation and waterway management	Important	Important	Important	Important
	Ice operations	**Critical**	**Critical**	Important	**Critical**
	Living marine resources	Important	Important	Important	Important
	Marine environmental protection	Important	**Critical**	**Critical**	**Critical**
	Other law enforcement	Potential	Potential	Potential	Important

Much work remains to describe, communicate, and address the potential gaps and associated vulnerabilities identified above. DHS should spearhead more-extensive planning and exercising for response in the Arctic than at present. While the USCG is a central player in the Arctic and will likely play an important role in many possible contingencies, others also need to be involved, including other DHS components. To make this collective response effective, the

[9] Note that even though a particular USCG mission might be important in the Arctic, this does not necessarily make any particular gap critical for that mission if there are assets available (at the time of writing) that can help perform some or all aspects of that mission, which is why this consideration was included in the vulnerability rating scale.

actors need to not only plan together but also exercise their capabilities in both tabletop and live exercises that improve the actors' interoperability and minimize seams between them.

The next steps for the USCG should include prioritizing Arctic CAR research to support the development of materiel and nonmateriel approaches for closing gaps. Importantly, the CAR should stress the presence of capability gaps, even given the acquisition of a new heavy icebreaker, which will facilitate an important but incremental step up in capability. The CAR should be accompanied by a detailed roadmap for future action with respect to strategy, planning, and acquisition tasks to support the improvement of Arctic capabilities. This roadmap should ensure that these processes do not stall following the submission of the CAR and provide continuity of action over coming years.

The USCG should also continue reviewing requirements for the Polar Icebreaker Recapitalization Ship to ensure that this vessel is best suited to meet the demands of a multimission environment. Features that should be carefully evaluated include command, control, and communications capabilities, along with crew space, to enable use of the cutter as an element to promote mobile sector operations in Arctic response; an MH-60 or other helicopter landing and refueling capability; law enforcement enablers, such as small boat landing ability; the capacity to carry small unmanned systems for surveillance and the ability to ingest and fuse these systems' information feeds with other sources of information; additional environmental hazard and medical equipment; and other multimission equipment and sensors, including those that might be applicable for future defense readiness missions.

Finally, a forthcoming Arctic CAR could suggest gaps that will cause the USCG to review and update its Arctic strategy, as well as develop related plans for implementation and specific concepts for different types of response. These response plans should be practiced in table-top and live exercises (among other training methods) in order to ensure readiness (with partners, including local communities) under a variety of circumstances.

It is important to remember that improvements to Arctic capabilities are a multipartner effort that involves a portfolio solution that includes both materiel and nonmateriel assets of various types. The Arctic region will always be a challenging one in which to operate, with vast distances, harsh conditions, sparse infrastructure, and limited assets. In the context of this environment, it will remain critical to leverage the collective capabilities of partner agencies at the international, federal, state, local, tribal, and private-sector levels. The ultimate goal is to close gaps before any major Arctic crisis necessitates action.

Acknowledgments

The authors of this report would like to thank CDR Eric Popiel and LCDR David Smith from the U.S. Coast Guard Office of Emerging Policy for their guidance and support throughout this research process. We also appreciate the assistance of the Arctic Domain Awareness Center in facilitating one of the workshops used for research data collection. The dozens of experts that kindly donated their time to participate in our workshops provided valuable insights that formed an important basis for deriving our results. Our RAND Corporation colleagues VADM (ret.) Robert Parker, CDR Eric Cooper, Sarah Weilant, Mark Hvizda, and Ezra Hecker assisted in the conduct of this research. Finally, we appreciate the assistance of our research reviewers, Stephanie Pezard and RADM (ret.) Thomas Atkin, in providing ongoing quality assurance for this work.

Abbreviations

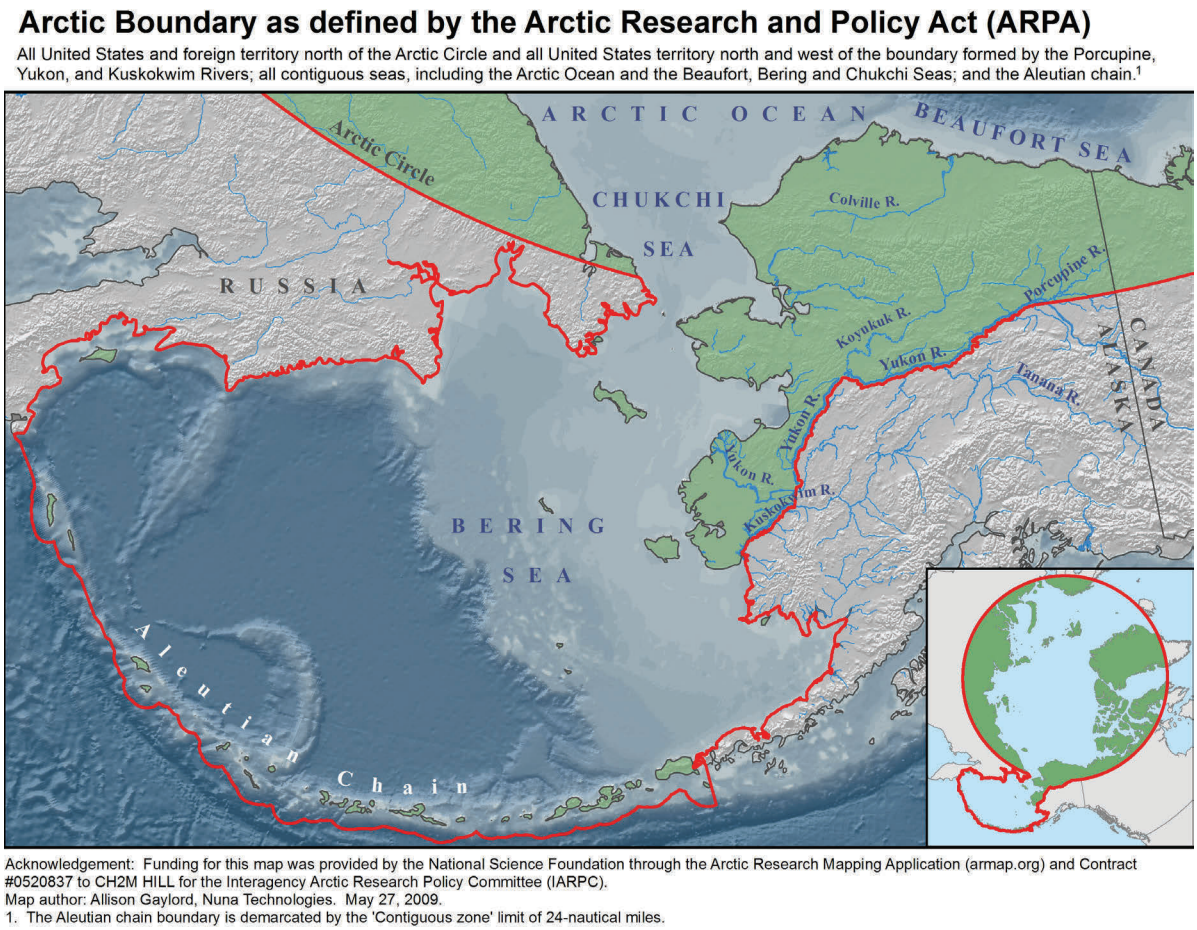
ADAC	Arctic Domain Awareness Center
AIS	Automatic Identification System
CAR	Capability Analysis Report
COSPAS	Cosmicheskaya Sistyema Poiska Avariynich Sudov
DHS	U.S. Department of Homeland Security
DoD	U.S. Department of Defense
EEZ	exclusive economic zone
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
ICE	Immigration and Customs Enforcement
JRIMS	Joint Requirements Integration Management System
NATO	North Atlantic Treaty Organization
NOAA	National Oceanic and Atmospheric Administration
SAR	search and rescue
SARSAT	Search and Rescue Satellite-Aided Tracking
TCO	transnational criminal organization
TSA	Transportation Security Administration
USCG	U.S. Coast Guard

1. Addressing Arctic Planning Challenges

The Arctic lies at the intersection of several challenges and potential opportunities for the United States. Most U.S. citizens living permanently in the region reside in traditionally resilient native communities with a rich cultural heritage that must increasingly absorb the effects of environmental and social disturbances. As of July 2016, much of the Arctic population lives within the North Slope Borough (around 9,600 people) and the Northwest Arctic Borough (around 7,700 people), where a substantial fraction of the population is under the age of 18.[1] There are also people who have relocated to support regional industries, such as resource extraction. The Arctic covers a vast area of land, sea, and air (see Figure 1.1), including areas within the Bering, Chukchi, and Beaufort Seas around Alaska. The Arctic is also becoming increasingly connected to the space and cyberspace domains.

[1] U.S. Census Bureau, "QuickFacts," webpage, undated.

Figure 1.1. Map of the U.S. Arctic



SOURCE: U.S. Arctic Research Commission, "Arctic Boundary Map: Alaska with Polar Inset," webpage, undated.

Since the beginning of the Cold War, the Arctic has borne geostrategic significance because of Alaska's long maritime border with northeastern Russia and the use of Arctic-based assets to detect and observe Soviet (later Russian) activity throughout the Arctic. Arctic and sub-Arctic Alaska also host military assets that play an important role in regional deterrence and potentially in global power projection. The Arctic also plays an important role with respect to air and missile defense in North America.

In recent years, much of the media attention regarding the Arctic has focused on its economic opportunities, both realized and anticipated. Although the United States has banned commercial fishing north of the Arctic Circle, the rich fisheries of the Bering Sea (which lies within the boundaries of the Arctic, as shown in Figure 1.1) provide a large percentage of the total U.S. commercial catch and represent an ongoing commercial opportunity. Fossil fuels have been extracted from the region for decades, and the scale of extraction could increase if demand for fossil fuels offsets the costs and risks of operations offshore. Moreover, the region has copious mineral resources, including one of the world's largest zinc mines, and the potential for other

mineral extraction. Another economic opportunity centers on the region's geography: Seasonally available Arctic shipping routes could enable faster intercontinental shipping with lower fuel costs than shipping via other routes between the north Atlantic and north Pacific. All such routes would require ships to transit the Bering Strait, an important maritime chokepoint along the U.S. boundary with Russia.

It could become increasingly possible to conduct economic activities in the region as the maritime environment becomes more accessible for longer parts of the year. The Arctic as a whole has experienced very rapid environmental change over the past few decades, altering the land and seascape. Generally speaking, these changes are resulting in smaller sea ice area for greater parts of the year (although the extent and pace of change will continue to vary), as well as melting permafrost and coastal erosion, which will hamper transit and maintenance of infrastructure on land due to greater instability of frozen ground and potential for land loss at the coast. The effects of melting permafrost and elevated sea levels are already destabilizing some coastal areas, including local communities.

However, despite generally higher-than-historical average temperatures, the Arctic remains a cold, harsh operating environment that can present a number of potential hazards to operators, including cold weather's impact on equipment, as well as rapidly changing conditions at sea, on land, and in the air. The challenges of the operating environment are exacerbated by a lack of infrastructure; assets; detailed plans to support communications, navigation, and domain awareness; and ability to respond to a variety of incidents, such as personnel in need of rescue or environmental contamination, that are regularly prepared for and addressed in other parts of the United States.

The United States has often lacked a widespread national focus on the Arctic, although changes in climate and resurging geopolitical tensions with Russia have recently brought the region more visibility. The recent U.S. chairmanship of the Arctic Council has also brought the region into greater focus nationally.[2] The United States has an overarching National Strategy for the Arctic Region, along with an accompanying implementation plan.[3] The U.S. Coast Guard (USCG), U.S. Department of Defense (DoD), and U.S. Navy also have Arctic strategies.[4] The United States has also been heavily involved in the Arctic Coast Guard Forum, which was

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[2] The Arctic Council is a diplomatic entity that facilitates discussions among Arctic nations and other stakeholders. It includes representation from all eight Arctic countries, as well as observers that include indigenous groups, the European Union, China, and several other countries. The Arctic Council promotes decisionmaking about Arctic affairs, such as search and rescue (SAR) and environmental issues, but does not address security from a military perspective.

[3] Office of the President of the United States, *National Strategy for the Arctic Region*, Washington, D.C., May 2013; and Arctic Executive Steering Committee, *Appendix A: Implementation Plan for the National Strategy for the Arctic Region*, Washington, D.C., March 2016.

[4] USCG, *Arctic Strategy*, Washington, D.C., May 2013; DoD, *Arctic Strategy*, Washington, D.C., November 2013; U.S. Navy Task Force Climate Change, *Arctic Roadmap for 2014 to 2030*, Washington, D.C., February 2014 (note that this is an update to the first Arctic Roadmap, which was published in 2009).

formally established in October 2015 and includes participation from all eight Arctic countries (the United States, Russia, Finland, Sweden, Norway, Iceland, Denmark [via Greenland], and Canada).[5] The forum focuses on promoting safe, secure, and environmentally responsible operations in the Arctic region.

Although this brief overview has touched on a number of important Arctic issues, there are many areas that the interested reader may wish to examine in more detail. There are several other publications regarding Arctic issues that contain additional background information.[6] Some of these themes are also further addressed in Appendix A, in which we discuss the development of Arctic scenarios.

U.S. Coast Guard Roles in the Arctic

Depending on the time of year, the USCG's District 17, which encompasses all of Alaska (including non-Arctic regions), has either few or no assets to cover areas above the Arctic Circle on a day-to-day basis.[7] As of 2017, there is no permanent USCG (or any U.S. government) presence in Alaska above the Arctic Circle. An icebreaker, a handful of other maritime vessels and aircraft, and a small amount of personnel based elsewhere within District 17 or farther south along the U.S. west coast are capable of assisting with USCG Arctic operations.[8] These resources are sometimes available in the Arctic during summer months, when Arctic sea ice is most diminished. This seasonal in-region presence reduces the vast distances assets and personnel would need to travel in order to conduct Arctic operations, although distances remain great under many circumstances even with seasonal USCG Arctic presence. The lack of infrastructure in Arctic Alaska to host people and assets and to facilitate operations, maintenance, and resupply inhibits a large or regular presence in the region.

Even if infrastructure were in place to support scaled-up presence in Arctic Alaska, District 17 has only a very limited number of assets to cover a vast area of sea, coast, and land in and around what is by far the largest U.S. state based on land area.[9] While the number of assets operating in District 17 varies over time, just 7 percent of all USCG cutter hours and 10 percent

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[5] Katie Braynard, "Establishment of the Arctic USCG Forum," *Coast Guard Compass*, October 30, 2015.

[6] See, for example, Thad W Allen, Christine Todd Whitman, Esther Brimmer, and Anya Schmemann, *Arctic Imperatives: Reinforcing U.S. Strategy of America's Fourth Coast*, New York: Council of Foreign Relations Press, March 2017; and Stephanie Pezard, Abbie Tingstad, Kristin Van Abel, and Scott Stephenson, *Maintaining Arctic Cooperation with Russia: Planning for Regional Change in the Far North*, Santa Monica, Calif.: RAND Corporation, RR-1731-RC, 2017.

[7] Districts are a USCG organizational construct that enable responsibilities and assets to be distributed within different geographic areas.

[8] DoD also has facilities with assets capable of operating south of the Arctic Circle in Alaska.

[9] USCG, "Welcome to the Seventeenth Coast Guard District," webpage, undated-b.

of fixed-wing aircraft hours were used in District 17 during fiscal year 2015,[10] as an example to illustrate the paucity of assets for such a vast region.

The USCG has 11 statutory missions,[11] which are grouped under the three broad categories of safety, security, and stewardship, as follows:

- safety missions
  - SAR
  - marine safety (accident prevention)
- security missions
  - ports, waterways, and coastal security (preventing maritime attacks)
  - drug interdiction
  - migrant interdiction
  - defense readiness (supporting the DoD)
- stewardship missions
  - aids to navigation and waterway management
  - ice operations (both icebreaking and monitoring of ice conditions)
  - living marine resources (overseeing domestic fisheries)
  - marine environmental protection (response to environmental spills)
  - other law enforcement (countering illegal international fishing).

The USCG performs many of these missions in the Arctic today. For example, SAR, marine safety and waterway management, defense readiness (particularly aspects related to peacetime engagement), aids to navigation, ice operations, marine environmental protection, and living marine resources are all very relevant in the 2017 time frame in which this report was prepared. Others, such as drug and migrant interdiction, are less immediately concerning, given the present challenges in accessing the Arctic, but cannot be ruled out for the future, given the regional transformations underway.

The research described in this report focuses on the 2030s. Naturally, the degree to which each USCG statutory mission will be performed in the Arctic in the 2030s will differ, and will depend on the extent of both legal and illicit activity in the region. The degree to which the two safety missions are likely to be performed will reflect maritime activity in the region, while the nature and scale of various threats will influence the extent to which the four security missions are performed. The stewardship missions are more heterogeneous: The need for the aids to navigation and ice operations missions will vary as a function of overall maritime activity and environmental conditions, while the scale of the living marine resources and other law enforcement missions will depend on the extent of legal commercial fishing and the degree to

[10] Scott Savitz, Anna Jean Wirth, Katherine Anania, Peter Buryk, Aaron C. Davenport, Michael Houlne, Andrew Lauland, Robert C. Parker, Elizabeth Tencza, Sarah Weilant, Stephen White, Henry H. Willis, and Dulani Woods, *Analyzing the Operational Impact of U.S. Coast Guard Asset Allocation for the Drug Interdiction and Living Marine Resources Enforcement Missions*, Santa Monica, Calif.: RAND Corporation, RR-1781-USCG, 2017.

[11] For more information, see USCG, "USCG: A Multi-Mission Force," webpage, undated-a.

which illegal commercial fishing is undertaken. As previously alluded to, although commercial fishing is currently banned in the U.S. exclusive economic zone (EEZ) north of the Arctic Circle, that may change, and our expansive definition of the Arctic—to include the waters of the Bering Sea—encompasses waters that are currently the source of much of the overall U.S. catch nationally.[12] The degree to which the marine environmental protection mission is performed will be a strong function of the scale and frequency of oil and other contaminant spills.

Although the USCG has historically been the most visible U.S. Department of Homeland Security (DHS) presence in the Arctic (indeed, its presence in the region—which began in 1867 with the U.S. purchase of Alaska—long predates the establishment of the department as an entity), there are present and potentially future Arctic missions that may benefit from or require a broader DHS response, including by such agencies as the Federal Emergency Management Agency (FEMA), Customs and Border Protection, the Transportation Security Administration (TSA), and the National Protection and Programs Directorate.[13] Agencies such as these could become particularly important in the event that there is even a modest increase in economic activity—especially if a deepwater port is established in Arctic Alaska, along with a larger, more capable airport—that could bring an increase in the flow of people to and through the region. Under these circumstances, there would also be a greater number of people and amount of infrastructure impacted by environmental challenges, further expanding potential roles for FEMA.

Arctic Capability Gaps

The challenges of operating in the Arctic have been well publicized.[14] The idea that gaps exist that inhibit the execution of safety, security, and stewardship mission-related activities in the Arctic is not a new one.[15] For example, Mead Treadwell, formerly chair of the U.S. Arctic Research Commission and lieutenant governor of Alaska, testified before a U.S. Senate subcommittee in 2009 about needs in the Arctic, including icebreakers, ice-strengthened research

[12] Other geographic definitions include those based on latitude and mean seasonal temperatures, which result in less land area in the Alaskan Arctic than the definition we employ.

[13] Charles Michel, "USCG Arctic Implementation Capabilities," testimony for the U.S. House of Representatives Committee on Transportation and Infrastructure, Subcommittee on USCG and Maritime Transportation, July 12, 2016.

[14] See Michel, 2016; Allen et al., 2017; Pezard et al., 2017.

[15] See Mead Treadwell, "U.S. Strategic Interests in the Age of an Accessible Arctic . . . What We Need to Know and Do Now," testimony for the U.S. Senate Committee on Appropriations, Subcommittee on Homeland Security, August 20, 2009; ABS Consulting, Potomac Wave Consulting, and Systems Planning and Analysis, Inc., "United States USCG High Latitude Region Mission Analysis Capstone Summary," July 2010; ADAC, "Arctic-Related Incidents of National Significance Workshop on Maritime Mass Rescue Operations: Rapporteur's Report," September 6, 2016; Arctic Executive Steering Committee, 2016; Allen et al., 2017.

vessels, sensor networks, aids to navigation, hydrographic mapping, and infrastructure onshore.[16] The "High Latitude Region Mission Analysis" study commissioned by the USCG and published in 2010 laid some of the analytic groundwork for plans to invest in a new icebreaker.[17] It focused on a capability gap identified in polar icebreaking, recommending investments in additional icebreakers, but also highlighted gaps in capabilities related to communications, presence of forward operating locations, and environmental response in ice-covered waters.[18] In 2012, General Charles Jacoby—at that time, commander of U.S. Northern Command and the North American Aerospace Defense Command —and Admiral Robert Papp—at that time, commandant of the USCG—announced four key areas in which the Arctic had gaps in capability, including communications, domain awareness, infrastructure, and presence.[19] The Arctic Domain Awareness Center (ADAC), a DHS Center of Excellence, has recently convened several workshops focused on different aspects of Arctic operations. In one workshop exploring incident response, several relevant themes related to gaps emerged, including communications in time of crisis; understanding of sea ice, weather conditions, and bathymetry; domain awareness and planning; and technologies to transport casualties from a disabled ship to a rescue vessel, among others.[20]

Although there are some differences in areas of emphasis and the degree of detail given in these and other reports and statements about Arctic operational needs, similar—or at least related —deficiencies tend to be present over and over again. These patterns suggest that, at least broadly speaking, many challenges for Arctic operations and needs in the region are fairly well known.

Despite persistent articulation of concerns, however, identified Arctic gaps and challenges have in large part remained unresolved, although plans to replace an aging heavy icebreaker constitute one of many needed steps in the right direction.[21] This brings into question whether the USCG has the capabilities it needs to conduct its statutory missions in the Arctic today, let alone in the 2030s, if the activity level in the Arctic increases and, with it, demand for USCG mission executions. Although the USCG Arctic Strategy provides insightful direction, more-detailed plans related to policies, plans, and investments (both materiel and nonmateriel) are needed to enable the USCG to confidently conduct Arctic operations today and, importantly, to continue doing so in a future Arctic that may be characterized by new, or more intense, challenges.

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[16] Treadwell, 2009.

[17] This report is in the process of being updated.

[18] ABS Consulting, Potomac Wave Consulting, and Systems Planning and Analysis, Inc., 2010.

[19] Robbin Laird, "America, Allies, and the Arctic: NORTHCOM Commander Talks Polar Strategy—EXCLUSIVE," *Breaking Defense*, December 14, 2012.

[20] ADAC, 2016.

[21] USCG Acquisition Directorate, "Polar Icebreaker: Program Overview," webpage, undated.

Why have Arctic gaps remained largely unresolved? It could be related to the fact that the Arctic has often not received the level of domestic political and economic focus that it has in many other Arctic (and, perhaps, also in some non-Arctic) countries, such as Russia and Norway.

To illustrate this point, there is noticeably more infrastructure and presence north of the Arctic Circle along the Eurasian coastline as compared with the North American Arctic coast.[22] This is largely due to economic development in the Eurasian Arctic (resulting, in part, from hydrocarbon extraction and fisheries in Russia and Norway), although Russia in particular has also recently and historically had a military presence in the region.[23] Russia maintains over a dozen Arctic ports, some of them large and quite capable (i.e., enabling access for very large vessels and containing substantial infrastructure onshore), including ports at Arkhangelsk, Murmansk, and Tiksi. There are also maritime and other facilities at Severomorsk, which serves as the headquarters base for Russia's Northern Fleet Joint Strategic Command. Russia has also invested in a large fleet of icebreakers (more than 40), and other Arctic capable enablers for presence, domain awareness, and communications.

Norway hosts two medium-sized ports above the Arctic Circle, including that at Tromsø, which is also a major Arctic urban center. There are also more than a dozen smaller ports in the Norwegian Arctic, including at Hammerfest. Although Norway has only one icebreaker (with another that appears planned), it has designed some of its naval and other (e.g., research) enablers to be capable of operating under harsh, polar conditions. Sweden and Finland lack Arctic coasts but have over 15 icebreakers combined. These icebreakers operate in the Baltic Sea but can also be used in some circumstances for Arctic operations. Canada has some ships, aircraft, and related onshore infrastructure to support Arctic operations, as does Denmark (in order to support its role in Greenland).

In contrast, the United States has very little onshore infrastructure above the Arctic Circle in Alaska,[24] as discussed earlier in this chapter. Although there is a deepwater port at Dutch Harbor (south of the Arctic Circle and hundreds of kilometers from far northern Alaska and the Chukchi Sea), there is no such capability further north. What ports and other limited infrastructure do exist are very small and designed mostly for local use—not for large USCG vessels or commercial ships. Similarly, airfields in northern Alaska are designed for smaller aircraft and do not feature much hangar space.

This contrast in Arctic operating capacity reflects the historically low level of national focus on Arctic issues in the United States. This has, predictably, been reflected in small budgets for Arctic-related initiatives. Furthermore, the effect of a large crisis in the region has not yet been

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[22] Arctic Council, *Arctic Marine Shipping Assessment*, Tromsø, Norway, 2009.

[23] Heather A. Conley and Caroline Rohloff, *The New Ice Curtain: Russia's Strategic Reach to the Arctic*, Washington, D.C.: Center for Strategic and International Studies, August 2015.

[24] Thule Air Base in Greenland hosts U.S. Air Force infrastructure and assets; these have a strategic focus, rather than a focus on the Arctic region.

felt; such a crisis could intensify motivation to close gaps, but it would come too late to avoid one or more incidents that might threaten life, security, the environment, and the economy.

Research Purpose, Objective, and Approach

The key Arctic strategy and planning challenge for DHS and the USCG is how to enhance activities to prepare for operations before a crisis comes to pass. One important step in doing so is the development of a Capabilities Analysis Report (CAR), one type of planning document within the broader DHS Joint Requirements Integration Management System (JRIMS) process. A CAR can help bring visibility to important challenges and assist in initiating processes that bring about both materiel and nonmateriel solutions. A well-constructed CAR relies on information detailing differences between the current state of capabilities and the desired future, and why these disparities are relevant for mission execution.

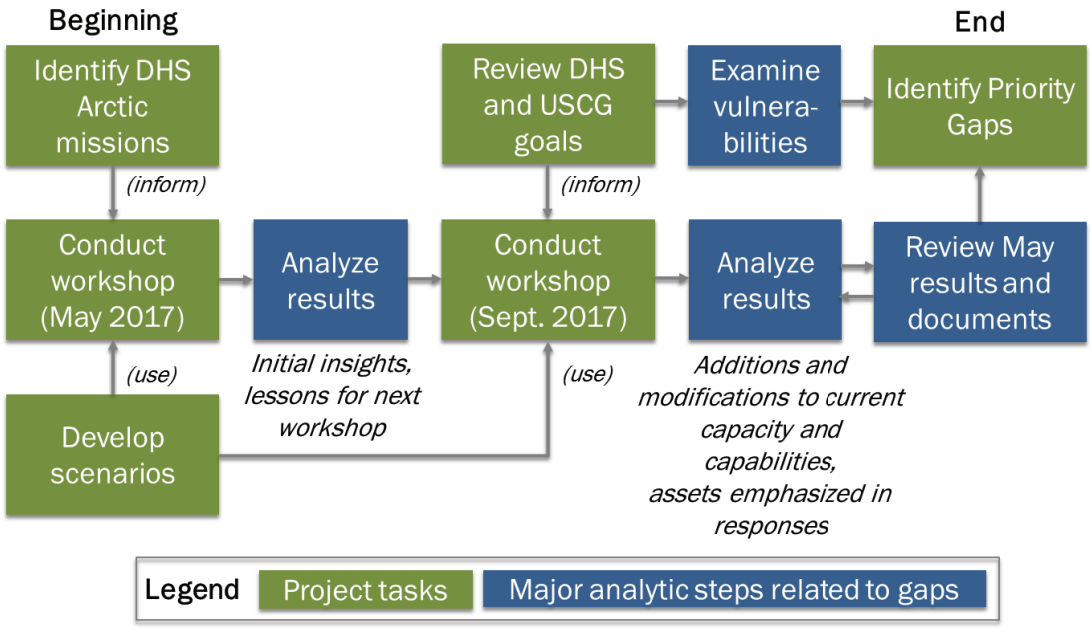
The research described in this report was designed to provide these important CAR inputs and seeks to provide USCG and DHS decisionmakers with a perspective on what potential gaps exist and how these gaps could endanger present USCG missions in the Arctic region. Although several previous reports and statements have articulated Arctic needs, challenges, gaps, and vulnerabilities—in some cases (e.g., communications), repeatedly—this new work provides a fresh look at potential gaps, using a structured, traceable approach that considers a broad spectrum of contingencies that DHS might have to respond to in the Arctic. As such, it provides a tailored platform from which to launch CAR development at this important juncture for the USCG and DHS. After considerable effort, a new polar icebreaker is on the horizon, but forward momentum on other fronts must be continued to ensure that other previously identified needs, along with potential new ones, are likewise planned for. Our aim with this research is to provide an input that is similar to a capability analysis for the USCG to employ in articulating needs and risks for present and potential future Arctic operations so that informed decisions can be made about mitigating or accepting risks to some missions.

Since the precise future profile of demand for USCG and, more broadly, DHS participation in Arctic operations is unclear, the Homeland Security Operational Analysis Center research team focused on the series of currently defined statutory missions that the USCG prepares to carry out across the United States, including in the Arctic.[25] Although we recognize the importance of other DHS components, this research largely focused on the USCG as the primary regional operator within the department, taking into account a broader DHS perspective when possible (e.g., through the benefits of including participation from DHS headquarters and other components in workshops conducted during the course of this research).

[25] We do not anticipate drastic changes to the overall USCG mission set by the 2030s, unless driven by a low-probability event, such as a major conflict.

The summary of our research approach is illustrated in Figure 1.2. We developed a framework for constructing Arctic scenarios that is inherently flexible, providing a starting point for building diverse future outlooks that can evolve as planners receive new information about how the Arctic is transforming. This framework was used to construct alternative scenarios for two facilitated, structured workshops, in which these alternative scenarios were used not to exercise participants' predictive capabilities but rather to facilitate discussion about responding to events in the Arctic in line with USCG and DHS focus areas that imposed different types of stresses on planning, coordination, communications, movements, and other factors. Workshop results led to the articulation of capability gaps for Arctic operations that were present in 2017 and could lead to increasing levels of risk to the ability of the USCG to conduct missions in the region by the 2030s. Linking the potential impact of these potential gaps to possible USCG statutory mission vulnerabilities enabled us to provide decisionmakers with an idea of what might be at stake if further action is not taken to better enable Arctic operations.

Figure 1.2. Summary of Research Approach



With respect to scope, this research focused on examining Arctic challenges and USCG capability gaps in the first instance, bearing in mind the USCG role within the broader DHS organization and the different components within DHS that have or might have relevant roles in the Arctic in 2017 or in the future. We largely focused on U.S. Arctic capabilities, with a limited amount of consideration of the importance of international partnerships and of which assets international partners might bring to the table in regional operations. Most of the work focused

on operating on the ocean, at the coast, or in the air. However, some consideration was given, when relevant, to other domains, including land, cyberspace, outer space, and the subsurface.

There are several terms that will be used throughout the report that we define in Table 1.1.

Table 1.1. Definition of Terms

Arctic	"…United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain"[a]
Capability	"The means to accomplish a mission, function, or objective"[b]
Capability gap	"Instance of a capability is required by DHS and/or its stakeholders/partners to perform a mission, function or objective, but they do not currently possess it and there are no plans for it to be provided by existing programs"[c]
Domain awareness	Understanding anything that could have an effect of safety, national security, the economy, and/or the environment[d]
Joint Requirements Integration and Management System (JRIMS)	"A process by which DHS reviews and validates capability requirements, associated gaps, and proposed solution approaches to mitigate those gaps"[e]
Persistent surveillance	A strategy and materiel to facilitate constant surveillance of a particular type of activity or a priority target that is of sufficient duration to provide information that enables action in a timely way[f]
Requirement	"Condition or capability that must be met or possessed by a system, product, service, result, or component to satisfy a contract, standard, specification, or other formally imposed document"[g]

[a] Public Law 101-609, Arctic Research and Policy Act of 1984 (amended 1990), Sec. 112, Definitions, November 16, 1990.
[b] DHS, *Department of Homeland Security Manual for the Operation of the Joint Requirements Integration and Management System*, DHS Instruction Manual 107-01-001-01, April 4, 2016, p. 3.
[c] DHS, 2016, pp. 3–4.
[d] DHS, *National Plan to Achieve Maritime Domain Awareness: For the National Strategy for Maritime Security*, October 2005.
[e] DHS, 2016, p. 5.
[f] Adapted from U.S. Joint Force Command, *Commander's Handbook for Persistent Surveillance*, Version 1.0, Suffolk, Va., June 20, 2011.
[g] DHS, 2016, p. 4.

In the chapters that follow, we first describe an expert workshop convened in September 2017 to update information on capability gaps in a format that would easily feed into an Arctic CAR (Chapter 2). In Chapter 3, we describe the potential capability gaps uncovered during the workshop. In Chapter 4, we outline a qualitative vulnerability scale developed for this work, and our examination of vulnerabilities to USCG statutory missions (as if performed in the Arctic) related to the potential capability gaps. Finally, in Chapter 5, we summarize our results and provide recommendations. Appendixes at the conclusion of this report discuss the details of our scenario development approach, use of logic models to examine potential relevance of enablers to different USCG tasks, and summary of an earlier expert workshop convened in May 2017.

2. An Expert Workshop to Identify Potential Arctic Capability Gaps

Two workshops with Arctic and DHS subject-matter experts constituted the primary means of data collection for identifying potential Arctic capability gaps.[1] We used the method of structured, scenario-driven workshops for data collection for a number of reasons. Workshops provided a fast and consistent way to access a wide variety of experts and stakeholders. Doing so also enabled us to leverage group dynamics to spur discussion and allow (in some cases) fresh ideas to emerge. Employing scenarios and the data collection sheets that yielded vital information for our analyses would have also been an awkward and time-consuming element to use in one-on-one interviews. Scenarios—the methodology and elements of which are described in Appendix A—were necessary to employ in order to provide sufficient context for answering questions about which enablers or assets should be prioritized in different types of operations.

The first workshop, hereafter referred to as Workshop I, was conducted May 11–12, 2017, at the University of Alaska Fairbanks. It was hosted in partnership with the USCG Office of Emerging Policy (the research sponsor), ADAC, and the University of Alaska Fairbanks. Participants included DHS and USCG experts, other federal agency representatives, Arctic scientists, DoD and Alaska state partners, and native Alaskan community members, among others. Our access to a range of Arctic experts was enabled by the fact that the workshop was part of a series of events accompanying an Arctic Council meeting in Fairbanks that attracted a large and diverse group of people. Workshop I was exploratory in nature, enabling structured gathering of information about factors participants felt were important in influencing Arctic futures, how alternative futures would shape DHS and USCG missions, and what types of enablers for operating in the region might be emphasized under three different sets of scenario circumstances.[2] It also yielded informative methodological insights that directly informed the structure of our next workshop and the approach taken to collect data about potential capability gaps. A full description of Workshop I and its results and key findings is available in Appendix C.

The second workshop, hereafter referred to as Workshop II, took place at USCG Headquarters in Washington, D.C., on September 25–26, 2017. This second effort incorporated

[1] Our access to key experts was limited, in both workshops, to those we were able to access at the time and place these events were held. We were not able to speak with all the experts who might have provided valuable insights for this research. However, the subset of experts that were able to participate in our workshops was highly qualified across different aspects of Arctic issues and operations and represented many different organizations within the USCG, DHS, and key Arctic partners.

[2] Workshop I did not in itself identify potential Arctic capability gaps in a way that could be incorporated into a CAR. The diversity of the participant group and the relatively small amount of expertise related to assets that can be employed for Arctic operations limited the amount of specific information derived from this event.

lessons from Workshop I to enable a very focused approach, in which a new set of participants[3] considered specific assets that could be used to respond to a diverse set of scenarios and how these might be modified or added to in order to construct a more effective portfolio of enablers for Arctic operations both in 2017 and in the 2030s. Using multiple different and diverse scenarios for Workshop II was quite important to capture a reasonably large subset of operation types that could theoretically occur in 2017 or at least by the 2030s under certain conditions. Appendix C provides a table summarizing key similarities and differences between the two workshops.

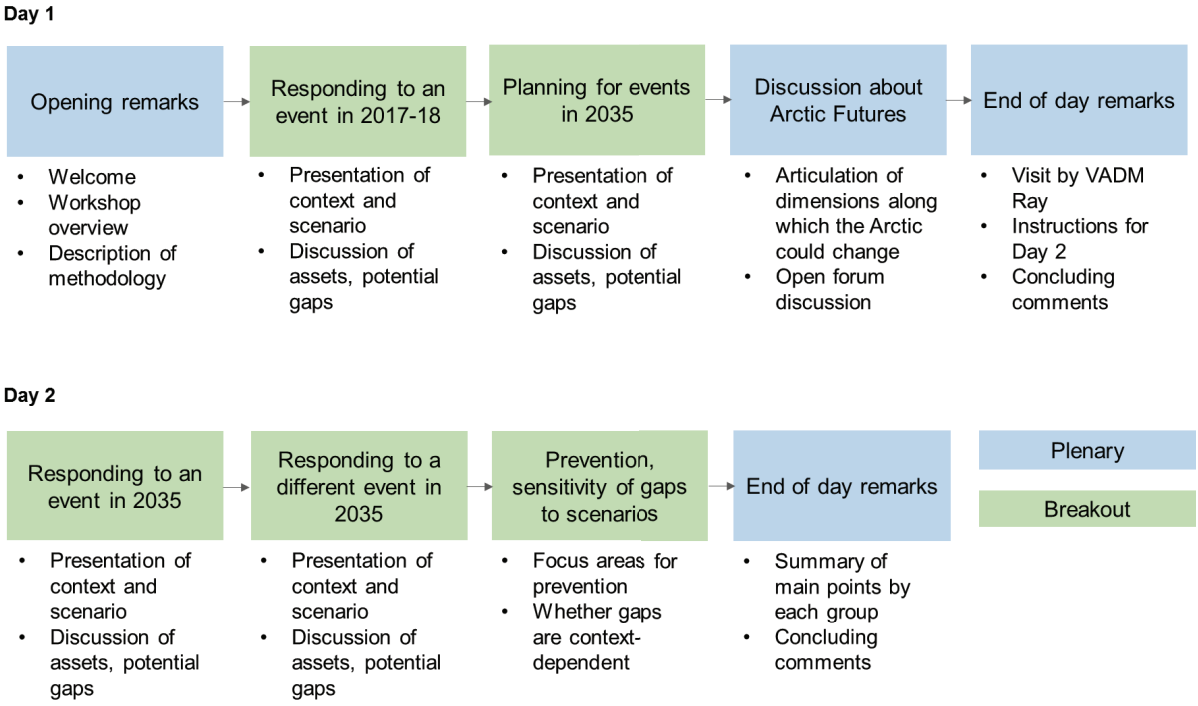
The approximately 30 experts enlisted to participate in Workshop II included a mix of senior and mid-level DHS and USCG operators, analysts, and planners, along with a handful of other senior civilian personnel serving in Arctic advisory roles within different DHS-affiliated organizations. Participants were carefully selected and distributed within breakout groups to provide diverse insights about specific types of assets (e.g., cutters, helicopters, satellites), organizations (e.g., sector headquarters), or types of missions (e.g., drug interdiction). This enabled focused, detailed discussions about the requirements for mission success in different scenarios, how current assets could or could not be used to perform the tasks required, and whether asset additions or modifications could improve outcomes.

Workshop II Approach

In Workshop II, we were able to estimate potential capability gaps by comparing, for each scenario, the difference between which currently available (or planned) assets participants selected as relevant to the response in question and which additional materiel and nonmateriel assets breakout groups felt were needed to provide a successful response (groups defined a successful response at the start of each scenario). By compiling this information across diverse scenarios—noting key patterns and some important outliers—we put forward four major potential capability gap areas, each with related subgaps and a diverse list of avenues by which to consider future remediation, which we discuss in the next chapter. Figure 2.1 broadly summarizes the order of events in Workshop II.

[3] A small minority of participants attended both workshops.

Figure 2.1. Summary of Workshop II Flow



Following opening remarks, participants divided into breakout groups. Each group explored a different scenario that took place in the present or very near future (sometime in 2017–2018).[4] This enabled participants to familiarize themselves with the workshop worksheets, which contained a list of 51 assets[5] that could be considered for Arctic operations. The worksheets also contained spaces to suggest additions and modifications and speculate on the quality of response using current and potential future assets.[6] Situating the first breakout session firmly in the present helped highlight issues in 2017, absent any possible changes. It also helped reduce participant challenges in adapting to a new data-gathering methodology and to the structure of an unfamiliar future world (a lesson that arose from Workshop I). The four events examined in the respective breakout groups for the 2017–2018 scenario included

[4] Workshop II had four breakout groups, each with a facilitator from the Homeland Security Operational Analysis Center, and one roving facilitator listened to discussions across groups. Breakout groups were designed to emphasize diversity in expertise.

[5] This did not include policies or plans, which were discussed separately from the worksheet activity during each breakout session. This also did not include potential international partner assets, which were provided for reference in a separate sheet and discussed following the deliberation on U.S.-based assets.

[6] At the beginning of each breakout session, we asked participants to read the scenario description and then suggest additional assumptions required for illustrating a particular response, as well as to use a rating scale for response, with 1 = Poor, or worst case, and 3 = Good, or best case. The rating scale turned out to be a useful tool for stimulating conversation about which additions or modifications were needed to improve response, but participants did not fill in the response rating on their worksheets consistently enough to enable formal analysis of these data.

- "Bump" (ship collision)
- "Over the Top" (downed passenger airliner)
- "Small Boats, Big Problems" (kayaktivists)
- "Storm Front" (small coastal community impacted by storm surge and severe weather).

The narratives for these events can be found in Appendix A.

These events were selected for the first breakout session because they are all very plausible in the present (e.g., ship collisions are a concern today as well as in the future, several commercial airline routes which take advantage of Arctic airspace). For this, and each of the other three four breakout sessions, participants were provided with short write-ups describing the "world" and the event taking place. Following discussion of additional assumptions and a rating scale for response, participants marked each of the 51 assets on their worksheets as critical or important or left a blank space to indicate that the asset was unimportant. Then, participants deliberated on possible additions (existing assets or entirely new assets) or modifications, and collectively chose a top-three list of additions and modifications to enhance response. After the first breakout session, facilitators met to discuss the top three additions and modifications from each breakout session and arrived at three new or modified assets, which were added to the list of 51 capabilities[7] for the next breakout session.

The second breakout session focused on planning for a narrow range of possible events in 2035, in contrast to breakout sessions three and four, which occurred on Day 2 of the workshop and involved responses in 2035 to events taking place in "real" time.[8] We made this distinction for two reasons. First, we wanted to follow a logical progression from responding to an event in the present, to planning for events in the future, to responding to events in the future. Second, it is possible that some participants would treat risk differently depending on whether the aim was to *plan* for a range of possible future events (spreading risk across different possible missions) or whether the incident was a *fait accompli* that required immediate response. Third, we wanted to further stimulate discussion by leaving participants focused on a particular set of potential future scenarios at the end of Day 1, and welcoming them back on Day 2 with a very different set of scenarios. Finally, adding this richness helped us ensure that we could cover a large amount of

[7] This was done in order to ensure that conversation did not stagnate repeatedly on the same issues to enable a broad range of potential gaps to be explored. For example, concern about communications was immediately raised in breakout session 1, so facilitators allowed for an upgrade to USCG cutter and aircraft satellite communications starting in breakout session 2, which helped participants focus on other potential challenges. We did not explicitly document data on how assets added during the course of the workshop (through facilitator deliberations between breakout sessions 1 and 2, and again between sessions 2 and 3) impacted response to future scenarios because participants did not consistently add these to their worksheets, despite instructions to do so. Even so, it was clear from the discussions during breakout sessions that participants generally figured the newly added assets into their decisionmaking calculus.

[8] We chose to use 2035 as a focal point for the 2030s to make the scenarios appear more concrete to participants; much can change within the course of a decade, and some participants in Workshop II found having to consider a decade as a whole distracting.

scenario territory in order to ensure that potential gaps identified were not particular to one or two scenarios.

The three events examined in the respective breakout groups for the 2035 planning scenario included

- "Build It and They Will Come" (existence of a new, deepwater port)
- "Deepwater Horizon North" (offshore oil rig explosion)
- "Icy Standoff" (protest against oil drilling for environmental reasons).

Participants were asked to collectively consider all three of these events, which were set within a world in which measured economic growth draws people and (largely legal) activity north (see Appendix A for more details). These events were selected because they raise different types of challenges but are also plausible as a group[9] and within the world in which they were set. After this second breakout session, facilitators once again derived three updates to the asset list based on prioritized additions and modifications proposed during participant discussions. These three updates were added to the previous ones from breakout session 1, bringing the list of assets for participants to consider on Day 2 to a total of 57.[10]

When they returned on Day 2, participants were given two 2035 scenarios, respectively, in back-to-back breakout sessions. In each session, participants were immersed in the same future world, which was characterized by increasing disorder, in which regulations loosen, people are on the move, and international ties weaken (see Appendix A for more details). These are the four events that were explored during breakout sessions three and four; each breakout group explored two different events in the respective sessions (one per session) and each event was given to only one breakout group per session:

- "Cyber Lights Out" (a suspected cyber attack takes out the power in three Arctic villages)
- "Fish Fight" (foreign vessels increasingly fish illegally in the U.S. EEZ)
- "Cold Terror" (a suspected terrorist attack occurs on a cruise ship)
- "Smugglers' Paradise" (illicit trafficking of humans and goods increases).

In breakout session 5—the final breakout session—participants discussed incident prevention (e.g., through regulations enforcement, training), identified the key findings from each of the previous breakout sessions, and talked about to what degree identified gaps represented broad challenges. At the workshop conclusion, one or two representatives from each breakout group reported a few key findings in a final plenary session.

[9] In that all three might occur within the same future time period.

[10] This included the 51 assets available today or currently planned, plus three from each of breakout sessions 1 and 2 that resulted from participant deliberations over priority additions and modifications. The six assets added during breakout sessions 1 and 2 included a deepwater port, mobile user objective systems on USCG cutters and aircraft, additional training and resources for local operating locations, six unmanned surface vehicles for surveillance, an intelligence fusion center, and universally available electronic aids to navigation.

Results

Three types of results emerged from Workshop II that provided helpful inputs to the estimation of potential capability gaps in the next chapter. First, we documented the top three priority asset additions or modifications proposed in each group for every breakout session. These provided direct indications about potential capability gaps because they represent changes to the status quo that participants felt were important to make in order to achieve better scenario responses. Second, we analyzed how critical or important participants suggested currently available or planned assets that might be available for Arctic operations were for addressing the challenges presented across the different scenarios. This information is helpful because it illustrates some potential areas for emphasis in a future Arctic asset portfolio by showing two things: (1) which types of assets were in highest demand and (2) the diversity of assets in demand. Finally, we list some of the key discussion points that arose during the meeting, compiled across breakout groups. These yielded additional and supporting insights for identifying potential gaps.

Quantitative Results

Table 2.1 summarizes the top three additions and modifications proposed by each group in Workshop II's first four breakout sessions. Several themes stand out when looking across breakout groups and sessions. These include emphases on communications, awareness of threats and hazards (including for the purpose of safe navigation), command and control, information fusion, development of plans, regional and local responders, logistics, and vehicles for accessing different areas under a variety of conditions. Participants were clearly interested in a wide variety of new assets but were somewhat less interested in adding capacity to existing assets. This was expected, as participants tended to reflect on the limitations of currently available assets while showing enthusiasm about fresh possibilities.

Table 2.1. Workshop II Priority Additions and Modifications

Breakout Session	Scenario Event	Three Priority Additions or Modifications
1 (respond in 2017)	"Bump"	1. Communications, including for civilian first responders and internationally 2. Regional response team and local first responders 3. International joint contingency plans
	"Over the Top"	1. Communications from on scene back to command 2. Expeditionary infrastructure and logistics to support unified command 3a. Local weather and ice dynamics data[a] 3b. Land-based medical support[a]
	"Small Boats, Big Problems"	1. Training and resources for local response 2. Improved cell network and satellite phone coverage 3. Permanent forward operating base
	"Storm Front"	1. Deepwater port

Breakout Session	Scenario Event	Three Priority Additions or Modifications
		2. Satellite communications (e.g., Mobile User Operating System) on cutters 3. Small boat beaching capability for cutters
2 (plan for 2035)	"Build It and They Will Come," "Deepwater Horizon North," "Icy Standoff" (Group 1)	1. Additional aids to navigation (e.g., waterway analysis management system, virtual aids to navigation) 2. Response assets for rapidly changing environments (e.g., amphibious vehicles, ice boats) 3. Enhanced workforce training in digital communications and data science
	(Group 2)	1. Response coordination cell 2. Infrastructure and logistics, including base support services 3. Enhanced agreements for information exchange
	(Group 3)	1a. Mobile command and control infrastructure 1b. Sustainment life support[b] 2. Heavy airlift, unmanned aerial vehicles (UAVs)
	(Group 4)	1. New Arctic sector with intelligence fusion center 2. Universal electronic aids to navigation 3. Unmanned systems for surveillance
3 (respond in 2035)	"Cyber Lights Out"	1. Strategy with clearly articulated objectives and coordination plan 2. Redundant communications especially for first responders 3. Infrastructure for aircraft operations and logistics
	"Fish Fight"	1. Multimission mobile sector 2. Manned and unmanned wide area surveillance 3. Motion sensors (e.g., to monitor fish stocks)
	"Cold Terror"	1. Airlift 2. Mobile command and control infrastructure 3. Universal translator for assistance communicating with foreign populations
	"Smugglers' Paradise"	1. International joint operations team 2. Advanced unmanned system for conducting lift and rescue operations 3. Information network overhaul to enable more-seamless data integration and analysis
4 (respond in 2035)	"Cyber Lights Out"	1. Redundant and self-isolating power systems (for incident prevention or effects mitigation) 2. Satellites for communications and surveillance 3. Pacific cyber response team
	"Fish Fight"	1. Articulation of risks and needs within U.S. government in order to inspire action to mitigate them 2. Network overhaul to enable more-seamless data integration and analysis, including cybersecurity features 3. More-robust agreements negotiated ahead of time to share information and assets between agencies and countries
	"Cold Terror"	1. Secure communications 2. International agreements for supporting response, especially with Canada and Russia 3. Seasonal forward operating location that could be mobile
	"Smugglers' Paradise"	1. Maritime sensor network to monitor movements on the sea 2. Integrated intelligence processing and fusion capability 3. Multimission mobile sector

[a] This group could not achieve agreement on the third priority within the time allotted.
[b] This group could not achieve agreement on the first priority within the time allotted.

As expected, the priorities emphasized also varied somewhat depending on scenario. For example, breakout session 2—in which participants considered the implications of a new deepwater port and enhanced hydrocarbon extraction activities—involved heavy discussion about improvements to navigation, port and logistics infrastructure, and domain awareness. In contrast, communications rose to the top of the priorities for several scenarios in other breakout sessions, possibly because of participant assumptions about existing communications assets or the additional communications capability associated with the new deepwater port.

Some themes were also consistent across breakout group discussions in different scenario contexts. For example, one breakout group consistently focused on command and control issues as part of its scenario discussions. This may reflect the particular professional experiences of the individuals in this group. Another breakout group began discussing issues related to information access and databases in session 3 that then carried over into session 4. It was not unexpected that group dynamics would result in some common themes being carried over from session to session, and facilitators worked to diversify discussion to ensure that the priorities eventually selected reflected the scenario at hand and not the ones discussed previously.

Table 2.2 shows the 51 currently available or planned assets that might be used for Arctic operations in the order of how favored they were by participants within the different workshop scenarios. These assets are also placed into three statistical tiers of favorability, which provides an overarching view of how important they were across all four scenarios. The table also shows the coefficient of variation, which indicates how much participants agreed on the favorability of the asset.[11] Although there are some fairly consistent findings that can be drawn from this table, it also demonstrates the sensitivity of asset relevance to the scenario and also the fairly large lack of consensus among participants.

[11] We converted participant designations of *critical* and *important* on the breakout session worksheets into two points for the former and one for the latter, and summed these up across participants and sessions. This is a way to look at favorability and is not ideal, as the designations used may have meant different levels of favorability to different participants. Future work might consider using a modified approach if the exact level of favorability is important. We also used a clustering algorithm to identify appropriate cutoffs for enablers that are collectively critical, important, or less important. We did this by conducting a hierarchical clustering on the overall points allocation made by participants. Before running the clustering, we normalized point allocations across sessions.

Table 2.2. Ranking of Existing or Planned Assets as Critical or Important in Scenarios

		Scenario			
Tier	**Asset or enabler**	**1st**	**2nd**	**3rd**	**4th**
Tier 1	MH-60 Jayhawk helicopters (8) (USCG)	**1**	5	**3**	1
	Airports and airfields (e.g., Deadhorse, Dillingham, Kotzebue, Nome, Utqiaġvik)	**4**	9	**4**	5
	National Security Cutters (USCG)	12	11	**1**	4
	Iridium satellite communications network (private)	**5**	7	13	6
	HC-130 aircraft (3) (USCG)	**3**	15	9	11
	Rescue Coordination Center (RCC) in Juneau (USCG)	6	14	11	10
	Automatic Identification System (AIS)	36	8	**2**	2
	Alaska Aviation Weather Unit (NOAA)	**2**	23	19	15
	Grey Eagle UAVs (DoD)	28	13	6	7
	The Coast Guard Sector Anchorage, including prevention and response personnel	11	19	18	8
	Global Satellite Imagery (international)	10	25	8	13
	AIS receiving stations (Marine Exchange of Alaska)	32	12	**5**	9
Tier 2	North Slope Forward Operating Location (FOL) (USCG)	16	16	10	22
	National Ice Center (NIC) (NOAA)	14	27	25	12
	Arctic Cap Nowcast/Forecast System (USN)	9	33	15	20
	Long Range Identification and Tracking System (LRIT)	40	26	14	3
	Alaska Rescue Coordination Center (DoD)	8	30	23	23
	COSPAS- SARSAT system (international)	15	28	17	24
	Commercial medevac	21	31	22	16
	HC-130 aircraft, including HH-60 refueling capability (DoD)	**7**	39	20	28
	Ports at Dutch Harbor and Nome	29	17	12	31
	Mobile User Objective System (MUOS) (USN)	34	20	28	18
	Polar Icebreaker Recapitalization Ship (USCG)	51	10	7	19
	Personal locator beacons	22	43	29	17
	Alaska Clean Seas response equipment (Alaska Clean Seas)	19	**1**	45	42
	Eielson and Elmendorf Air Force Bases (DoD)	30	36	24	25
	Medical personnel from 212th AF and AKANG (DoD)	23	40	21	30
	Specialized Coast Guard Response Teams	39	18	27	26
	Healy Icebreaker (USCG)	13	32	36	37
	MH-65 Dolphin helicopters (5) (USCG)	18	38	32	29
	NGA analysis products	44	44	16	14
	Spill Response Equipment (SUPSALV) (USCG)	33	**2**	40	45
Tier 3	Alex Haley Medium Endurance Cutter, including capability to facilitate MH-65 operations (USCG)	20	41	31	36
	Buoy Tenders (5) (USCG)	42	24	26	32
	Spilled Oil Recovery Systems (4) (USCG)	38	**3**	41	49
	Alaska Regional Response Team	35	21	33	40
	HH-60 Pavehawk helicopters (DoD)	17	47	34	34
	S-92 helicopters (2) (North Slope Borough)	25	42	39	38
	Vessel of Opportunity Skimming System (VOSS) (USCG)	45	**4**	43	50
	UH-60 Blackhawk helicopters (DoD)	26	46	42	35
	Data Buoys (NOAA)	37	34	30	41
	Patrol Boats (8) (USCG)	49	35	38	21
	Response Equipment (51 caches)	41	22	35	44
	Bell 412 helicopters (North Slope Borough)	24	45	44	39
	CH-47 Chinook aircraft (DoD)	27	49	46	33
	Aerial Dispersant Delivery System (ADDS) (USCG)	47	6	47	47
	Response equipment sites (7)	43	29	37	48
	Fixed aids to navigation (government and private)	50	37	49	27
	Munro High Endurance Cutter (USCG)	31	50	50	43
	Polar Star Icebreaker (USCG)	46	48	48	46
	Nathaniel B. Palmer Icebreaker (NSF, leased)	48	51	51	51

NOTE: AF = U.S. Air Force; COSPOS-SARSAT = Cosmicheskaya Sistyema Poiska Avariynich Sudov–Search and Rescue Satellite-Aided Tracking; NSF = U.S. National Science Foundation; NOAA = National Oceanographic and Atmospheric Administration; USN = U.S. Navy. Rankings in **bold** indicate a high level of participant consensus about the rank (coefficient of variation less than 0.5).

Table 2.2 offers a snapshot of participants' judgment of the relevancy of existing or planned assets in the different scenarios. Some assets do appear fairly consistently favored (e.g., MH-60 helicopters, airports and airfields, National Security Cutters, Iridium satellite communications), whereas others were favored much more in some sessions over others. This appears especially true for oil spill response equipment (e.g., Alaska Clean Seas equipment).

There were also some assets that were fairly consistently considered unimportant across breakout sessions, such as the fixed aids to navigation and some of the older cutters. Although participants were instructed to only consider an asset's capability in their responses, regardless of where that asset was in its life cycle, the results were very likely impacted by participants' perceptions of which assets will either be newly available or retired by the 2030s.[12] This is probably why, for example, the *Munro* and *Polar Star* (cutters that are near the end of their operational lives) were consistently deemed of low necessity to response across the different scenarios, and why the Polar Icebreaker Recapitalization Ship appeared fairly important, except in session 1 (which was set in 2017–2018, before the planned icebreaker would be available).

To some extent, assets that were ranked highly in session 2 were not considered as important in the other sessions. This is because session 2 focused on scenarios in which oil spills were important, which was not the case for the other sessions. The top four assets selected overall in session 2 are all designed for oil spill response.

Table 2.2 also highlights that participants within breakout sessions often did not agree on the relative ranks of the different assets. This is to be expected, given how different the scenarios were, except for session 2, where all groups examined the same scenario. Still, the coefficient of variation values for session 2 are not particularly lower (signaling higher levels of agreement) than other sessions (for some assets they are higher for session 2, indicating higher levels of disagreement). Some exceptions to the rule include MH-60 helicopters, airports and airfields, National Security Cutters, Iridium satellite communications, HC-130 aircraft, and the Rescue Coordination Center in Juneau, along with some of the oil spill equipment in session 2. Because of the limited size of the breakout groups, we did not examine statistical agreement within the groups themselves.

Qualitative Results

There were also several key discussion points from the workshop, which complemented the structured analyses presented in the tables above. We summarize some of the main points in the

[12] Workshop instructions indicated that if an asset was due to be replaced before the time frame in which the scenario was conducted, participants should assume—for the purposes of the exercise—replacement with an identical asset. Instructions were not clear on how to treat the planned Polar Icebreaker Recapitalization Ship as an asset in 2017; many participants appear to have considered that asset as not available in the current time period, which is a reasonable assumption because that is the current status. However, future workshops should emphasize that planned assets be included with active assets if capabilities are being evaluated in the manner of Workshop II.

paragraphs below, which were derived by compiling notes from the workshop facilitators, in particular leveraging the roving facilitator's bird's eye perspective.

Participants suggested that both nonmateriel and materiel investments are needed. While polar icebreakers are the most visible assets related to the region, they need to be complemented by other capabilities. Icebreakers are critical to creating accessibility for other vessels, but their slow speed of advance and relative scarcity mean that it is unlikely that one will be near enough to provide timely support in any given scenario. While expanding the polar icebreaker fleet from its current size of two vessels (one medium and one heavy) would reduce this scarcity, it would not abolish it. Even if billions of dollars could be found to build, maintain, and operate additional icebreakers, the vast distances of the Arctic would still limit the speed with which they could arrive at the scene of an unexpected situation. As they worked through scenario responses, some participants seemed surprised that icebreakers were not always central to addressing needs.

Some of the additional assets needed include forward basing in the region, which might be extended year-round. Key logistical enablers include fixed-wing and rotary-wing aircraft, as well as lighter-than-air airships to move large loads or masses of people. Reliable, low-latency communications within and beyond the USCG are a prerequisite for success. Such communications can leverage increasingly dense satellite constellations, as well as airborne and wired assets. The need for communications capabilities extends beyond manned platforms: Numerous, well-networked, autonomous systems could help accomplish missions. They could provide the detailed information on local conditions needed to enable operations in this extreme environment, as well as broader intelligence, surveillance, and reconnaissance (which can also benefit from satellite imagery). Some unmanned systems could also deliver goods. Lastly, enhancing USCG regulatory authorities could ensure that commercial entities achieve higher standards in terms of incident prevention, initial response capabilities, and systemic resilience, alleviating some demand for USCG response.

As networks of unmanned and manned systems are developed, they need to be protected against physical attacks and electronic interference, as well as cyber attacks. They also need to be designed for resilience against the risks inherent in operating in this remote environment. The USCG will need to hire and train people with the necessary skills in robotics, data science, cyber defense, and related fields to help secure these networks and enhance ability to leverage data analysis and advances in engineering. It can leverage their skills to create an interagency and international fusion center. Such a fusion center would integrate and analyze diverse data streams to create actionable information that can be disseminated within the USCG and (when appropriate) to partners. It could be coupled with a new Arctic USCG sector, which would also serve as a hub for operations.

The importance of cross-agency collaboration was underscored on numerous occasions. All agencies have limited capabilities and capacities in the region, so finding ways in which to leverage others' strengths was a recurring theme in multiple scenario discussions. Naturally, federal, state, local, tribal, international, and private-sector partners all have different procedures

and communications channels; they also may not understand what others have to offer. Collaborative planning, tabletop exercises, and live exercises can help overcome these issues. Expanding communications links, agreements, and interoperability standards with all of the USCG's partners will be critical to success in the region.

An important aspect of partnerships involves improving long-term relationships with native communities that can help make them more capable and more resilient, while also drawing on their detailed knowledge of the environment. Designating liaisons and expanding USCG cultural training can help ensure that all parties recognize the alignment of USCG goals with community interests. Such efforts can dovetail well with expanded training of native communities in prevention and response, along with select infrastructure development and prepositioning of key response items in those communities.

A key consideration for all Arctic response is that it is inherently expeditionary, with a need for mobile assets that can help overcome the region's vast distances. Designing sets of platforms and deployable teams with an expeditionary mindset can enable mass evacuations, the provision of emergency medical care, and achievement of other essential missions in the region.

Finally, this analysis indicates that there are significant gaps that the current USCG Arctic strategy does not fully address. As such, it also indicates that the USCG should update its Arctic Strategy to provide greater specificity regarding how to achieve more-detailed goals than were enumerated in the initial document. Such an update can also provide a venue for further elicitation of ideas on how to make the USCG more capable for Arctic response.

Summary of Key Findings

The following key findings emerged from Workshop II, which directly influenced the identification of potential gaps and possible avenues for remediation detailed in the next chapter:

1. Despite the existence of some assets that could be used in the Arctic, these may not be sufficient to promote effective USCG and partner response both currently and in the 2030s, because of a lack of capacity and capability to consistently access and sustain operations.[13]
2. No single asset, icebreaker or otherwise, will alone drastically improve the USCG's ability to operate in the Arctic.
3. Communications, awareness of threats and hazards, and ability to respond to and prevent incidents from occurring in the first place are all important considerations for Arctic operations.
4. Both materiel and nonmateriel enablers are important for enhancing Arctic capabilities.

In the next chapter, we use the results from Workshop II to characterize four broad potential Arctic capability gaps and several subgaps.

[13] Given the uniqueness of the Arctic operating environment, it is not surprising that assets designed for and used in broader geographic areas may not be effective or available for Arctic operations.

3. Identifying Potential USCG Arctic Capability Gaps

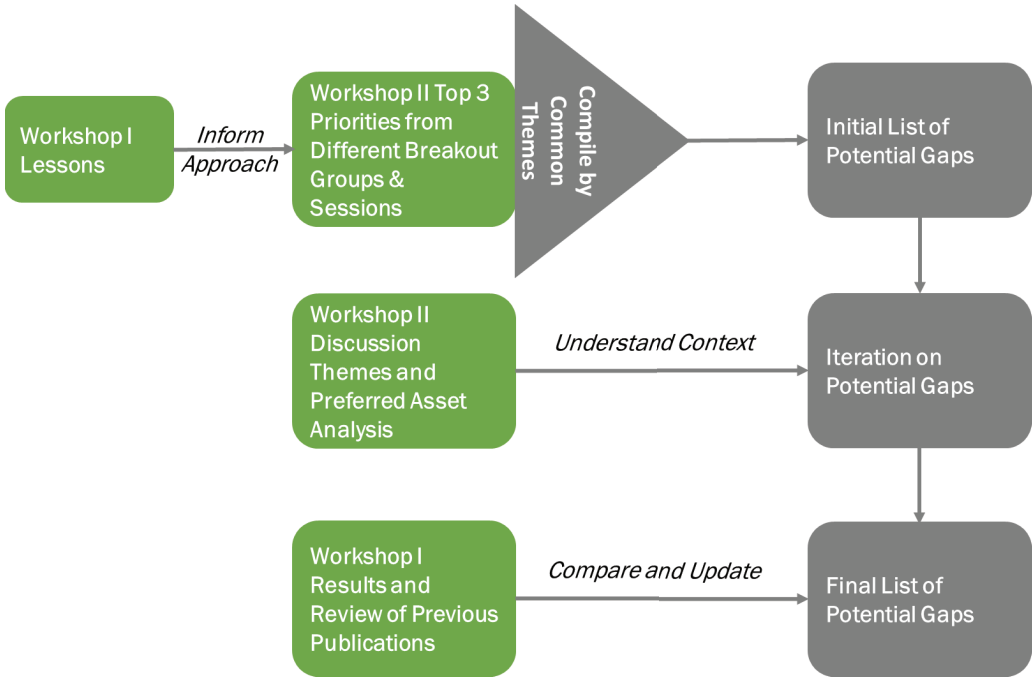
Concerns about a lack of ability to effectively operate in the Arctic have been voiced for some years, and there have been reports suggesting different types of gaps inhibiting regional operations.[1] The research process used here adds both additional substance and structure to the ultimate goal of articulating potential gaps. This helps ensure that potential issues are not missed and creates arguments for closing gaps that will resonate with decisionmakers.

How Potential Gaps Were Estimated

The research team used an iterative process to arrive at a list of potential Arctic capability gaps. We first analyzed the information in Table 2.1 (discussed in Chapter 2) for common themes to arrive at initial groupings of similarly focused priority needs. We then used our analysis of preferred assets (Table 2.2 in the previous chapter) and discussion themes from Workshop II to provide additional context that helped further categorize major potential gap areas and enabled us to identify possible mitigation avenues. Finally, we reviewed results from Workshop I (see Appendix C) to see whether our gaps derived from Workshop II results were consistent and, in some cases, incorporated perspectives and findings from Workshop I that helped enrich our description of the potential gaps. This process is summarized in Figure 3.1.

[1] See, for example, ABS Consulting, Potomac Wave Consulting, and Systems Planning and Analysis, Inc., 2010; Arctic Domain Awareness Center, September 6, 2016.

Figure 3.1. Process for Identifying Potential Gaps



Summary of Potential Gaps

Through the process described above, we arrived at three broad potential capability gaps, each with two or more subgaps, which we summarize here and discuss in greater detail in the remainder of this chapter, as well as a fourth gap in USCG and DHS institutional capabilities needed to address the first three gaps. Subgaps are articulated in Table 3.1 in terms of *what cannot consistently be done* in 2017 that could create vulnerabilities, potentially causing detriment to human life, environmental quality, security, or economic potential.

Table 3.1. Summary of Potential Arctic Capability/Institutional Gaps and Subgaps

Capability/Institutional Gap Area	Subgaps
Limitations in voice and data communications	• Transmission of voice within the Arctic so that anyone, anywhere can be reached 24-7-365 • Regular transmission of data—including text, still images, motion imagery, and recorded sound—between safety, law enforcement, and defense partners
Lack of consistent awareness about threats and hazards	• Persistent coverage across the entire Arctic (including U.S. territory and key "seams" or transitions between U.S. and either international waters and airspace or other territories), particularly for previously unidentified threats and hazards that do not or cannot actively emit signals (e.g., "dark" vessels, fast-moving ice) • Information fusion from individual data streams into a unified picture of activity and conditions (including access to historical information) • Clarification of whether existing sensors (regardless of the platforms that could carry them) are able to capture the full range of information required about a diverse set of hazards and threats, and how their functionality is impacted by Arctic conditions
Challenges in the ability to respond to incidents, including command, control, coordination, and access; addressing threats and hazards before they become problems	• On scene arrival along a timeline meaningful for an effective response (e.g., before casualties are likely, or prior to a threat or hazard crossing international boundaries) • People and assets deployed rapidly, and in the right combinations and order • Support to all the required response tasks • On scene persistence that is sufficiently long to perform the required mission and sustainment of operations over days, weeks, or months, as required • Further reduction of threats and hazards—or encouraging others to do so—in order to limit need for response
Deficiency in persuasively articulating needs and risks associated with Arctic operations to decisionmakers	• Systematic identification and regular review of gaps and detailed potential remediation measures using a repeatable process that encompasses a wide range of possible future demands • Documentation of the contributions that specific enablers make toward enabling capabilities • Illustration of risk associated with not closing gaps, especially in quantitative terms

Although these gaps are distinct, they have impacts on each other. Some clear examples include the need for communications to transmit domain awareness information and the need for navigation information to ensure safe operation of response assets.

These gaps are not new; rather, they articulate problems that have persisted for years and have become increasingly problematic as activity and (perhaps even more so) expectations of activity in the Arctic have increased. Indeed, some of these gaps (or gaps very similar to them) have been previously described, as discussed earlier in this report. However, this articulation of Arctic capability gaps provides a fresh, updated look at potential gaps in the context of numerous scenarios that focus explicitly on events and futures that DHS specifically might find challenging. This work also derived these potential gaps using a very structured approach that allows findings to be traced back to information collected in Workshop II (with some corroborating information gleaned from Workshop I). Furthermore, our description of the potential gaps below provides details that enable CAR development, including why the gap is important, some current assets that can be employed to perform aspects of the capability

associated with the gap, what beyond the 2017 status of the capability is needed, possible origins of the gap (i.e., is it linked to a capacity problem or something else), and some examples of possible avenues for mitigation. As illustrated in the sections that follow, we also provide detailed descriptions of what types of capabilities, in addition to more icebreaking capacity, will be needed to extend and supplement the planned new heavy icebreaker.

Limitations in Voice and Data Communications

How would we be informed that there is a problem? What method would we use to talk with the people involved in the incident, or with our partners? Is it possible to send that data feed to the people that need it? These are generic ways of asking some of the questions about communications that were commonly heard from participants during the breakout sessions at both Workshops I and II. The fact that communicating in the Arctic can be extremely challenging is not a new revelation. Communications remain a persistent and important problem in the region and is "square one" of any mission anywhere in that very little else is possible without it. Operating in the absence of communications is arguably more dangerous in the Arctic than in many other places, given the vast distances, risky operating conditions, small population, and very limited infrastructure.

At present, Arctic operations rely on voice communications via existing radio frequency capabilities and some satellite capabilities (e.g., Iridium and the Mobile User Objective System [a satellite-based system employed by the U.S. Navy but not yet available to the USCG]). Cell phone communications are extremely limited. Data transmission is even more challenging than for voice communications. Some of the domain awareness technology for supporting SAR discussed in the next subsection can also be considered a basic form of communications within the limited confines of this mission. An example of this is the personal locator beacon that allows people in distress to alert authorities.

Why Is Communications a Gap?

Participants in both Workshops I and II observed that communications capability in the Arctic was woefully inadequate for responding to the scenarios they were given. Many participants were concerned about the reliability of voice communications in the Arctic, due to reliance primarily on radio frequency transmissions and limited commercial satellite capability (if available), as well as potential incompatibilities with partner systems. Participants described Arctic voice communications with such words as "extremely limited," "patchy," and "unreliable," and expressed a desire to go from a state where it is uncertain whether a voice connection can be made—and, if it is, whether it can be sustained (and with which partners)—to a condition where anyone can be reached via voice transmission if needed anywhere in the Arctic, at all hours of the day, and all year long. Many participants expressed the need to reach a

variety of incident stakeholders that would be involved in the scenarios, including the people impacted on scene, first responders, interagency partners, and international partners.

A smaller subset of participants brought forward the issue of data communications, which one person described as "virtually nonexistent," at least in terms of USCG and DHS capabilities. Even though it could be argued that universal data transmission alongside voice would be helpful in the Arctic, the participants that brought this up focused more narrowly on the need for data transmission to enable sharing of text, still images, motion imagery, and recorded sound with partners involved in incident response.

There are several reasons why communications in the Arctic are more challenging than in the continental United States. The sparse infrastructure and vast distances within the region hinder communications, as do the even greater distances between the region and the outside world. Weather conditions (rain, snow, wind, and ice) also hamper the ability to establish communications. Moreover, satellite communications in the Arctic have generally been limited by the fact that relatively few satellites are in polar orbits, although some commercial satellite providers are now launching satellites in those orbits. These problems are exacerbated by unique atmospheric effects at high latitudes that can interfere with parts of the electromagnetic spectrum used for communications. The result is that communications among response platforms, or between response platforms and coordination centers, can have limited reliability and bandwidth. These communications challenges are in addition to the usual ones encountered in the continental United States, such as agencies not having common radio frequencies or common systems for encrypting and decrypting communications.

Possible Avenues for Remediation

One approach to countering this problem is to install additional infrastructure. However, a key challenge in doing so is the extreme nature of the environment, which can quickly deteriorate equipment that has been expensively emplaced in the region. Environmental effects can be exacerbated by the changing Arctic climate, since thawing permafrost, high winds, or rising seas can also inflict damage. A complementary approach is to leverage the growing number of commercial communications satellites in polar orbits.

A third approach is to alter tactics, techniques, and procedures, and to exercise them, to achieve a greater level of communications discipline in learning to manage with attenuated communications channels. In a high-bandwidth world, it is natural to adhere to communications protocols that make use of ample communications capabilities, but some of these protocols may need to be adapted for Arctic conditions. Exercising the ability to coordinate actions with low rates of moderately reliable data transmission could help overcome the fact that such circumstances may be a feature of life in the Arctic, particularly in emergency situations when communications systems may be damaged or saturated.

Even though participants were very vocal in appreciating the severity of the problem, few were able to articulate specific needs, requirements, or potential solutions, which may highlight

the severity of the gap and the need to better understand and document this gap. Much more work may be required in order to fully appreciate the specific priority requirements associated with this gap and how to mitigate them with materiel and, perhaps, nonmateriel solutions.

Lack of Consistent Awareness About Threats and Hazards

Even fully remediating the communications gap does not resolve the complementary issues of data gathering, analysis, interpretation, and dissemination, which are vital to supporting decisionmaking from strategic to tactical levels. Examples that illustrate the range of decision types needed for Arctic operations (in 2017, which may expand and broaden by the 2030s) include assessing whether there is a hazard or threat requiring a response (and what type of response) and avoiding other ships and ice.

Without sufficient awareness in the Arctic, the USCG and DHS more broadly are faced with nearly constantly operating in a slow, reactive state in which threats and hazards can cause operational and tactical surprise. These surprises reduce the time available in which to make decisions about responses—if those decisions have not already been compromised by new developments that further limit options for action.

Therefore, it is very important to have the ability to identify and evaluate a range of threats and hazards that are potentially present in the Arctic, as these threats may expand in number or broaden in character by the 2030s. Further, operating by land, air, or sea is especially challenging in the Arctic and other remote areas, where distances are vast and conditions are extreme. Arctic operators face the triple challenge of navigating with few fixed aids to navigation, several areas of poorly charted waters, and the potential for fast-moving ice and low visibility. Despite the fact that operators do go to the Arctic armed with best-available weather and navigation information and often return without major incident, there are nonetheless an increasing number of potential hazards posed by the possibility of increasing presence and transit in the Arctic. Further, the USCG and DHS require navigation and weather information to conduct any Arctic responses, which means that this factor is important for both the potential demand for services and the ability to supply them.

Some satellites, sensors on ships and aircraft, and various fixed assets are currently available to provide domain awareness, navigation, and weather information in the Arctic. Some of these primary assets are

- the COSPAS-SARSAT system—a satellite-based international collaboration to facilitate search during SAR missions
- personal locator beacons (which send signals to a COSPAS, SARSAT, or Geostationary Operational Environmental Satellite)
- various sources of satellite imagery and products, including National Geospatial-Intelligence Agency analysis products
- the AIS on ships and associated land-based receiving stations operated by the Marine Exchange of Alaska

- the Long-Range Identification and Tracking system and sensors on USCG cutters and aircraft.

Under some circumstances, DoD assets might be made available, but these must be tasked under a Defense Support to Civil Authorities mission, which is not a primary focus for DoD. With respect to navigation, there are a limited number of fixed aids, as well as the use of AIS, for this purpose.

Why Is Awareness a Gap?

Participants in Workshops I and II expressed—with varying degrees of concern—that enablers available or planned in 2017 lack the collective ability to provide persistent coverage across the entire Arctic (including U.S. territory and key "seams" or transitions between U.S. and either international waters or airspace or other territories). Information cannot routinely be fused from individual data streams into a unified picture of activity and conditions (including access to historical information) in the region.

Based on insights from Workshops I and II, these problems of persistence and coverage are particularly intense for the surveillance and tracking of previously unidentified threats and hazards that do not or cannot actively emit signals (e.g., "dark" vessels, fast-moving ice) because the capacity and capability is not present to confidently establish rapid awareness of what might be termed "unknown unknowns" across an area as large as the Arctic. Although somewhat less stressing, providing sufficient awareness of known potential threats or hazards (e.g., other vessels cooperatively using AIS, persistently adverse weather or ice conditions, an already-identified oil spill) can also be impacted by limited capacity and compounding challenges, such as inability to operate sensors (or the vessels that carry them) in Arctic conditions.

It is also not always clear whether existing sensors (regardless of the platforms that could carry them) are able to capture the full range of information required about a diverse set of hazards and threats that are potentially present now and could (in some cases) become even more important by the 2030s. This may be due, in part, to the relatively small number of opportunities to test sensor effectiveness against different hazards and threats in the Arctic.

Future needs that some workshop participants expressed included

- persistent coverage across the Arctic
- improved data quality and ability to exploit more types and greater volume of information
- warning of various potential threats and hazards, such as oil and other environmental hazards, and vessels suspected of illicit activities, including whether crews were armed and prepared to attack
- ability to fuse information from multiple sources, including that coming from on board cutters and aircraft
- continuous, seamless navigation information.

Limited coverage and persistence for domain awareness and navigation is perhaps first and foremost a capacity issue; very few assets that could regularly provide information (or be rapidly called on scene to do so) are available to cover the Arctic and surrounding areas all day, every day. Even if they were, the ability to rapidly exploit and fuse the data into information helpful for DHS decisionmakers and responders, as well as mariners, local populations, and others operating in the region, is broadly lacking. Notably, work by NOAA to provide information on ice conditions; information enabled by ship-carried AIS and collected, exploited, and disseminated by the Marine Exchange of Alaska; and the COSPAS-SARSAT system supplemented by the distribution of personal locator beacons are good examples of ongoing efforts to enable awareness in the Arctic. Much more is needed, however, to provide a consistent, persistent "common operating picture" that will enable the USCG and DHS to conduct the full range of services these organizations provide elsewhere in the United States.

Possible Avenues for Remediation

Remotely controlled air, sea, and amphibious craft could offer some compelling options for providing persistent wide-area surveillance, especially if networked together and with sensors on other assets to help provide a common operating picture. Universally available virtual aids to navigation could be beneficial both for navigation and as a supplementary source of domain awareness information. There may also be means for working more closely with the Intelligence Community to tie in additional sources of information. Effective use of these data could require a major update of data-gathering and database construction processes to enhance the role of automation for the purposes of improving data quality, making data accessible, and fusing information into a common operating picture.

The potential for remotely operated or "unmanned" systems in the air, on the sea, and on land to provide domain awareness has not gone unnoticed; there have been a number of research efforts, and one of the airspace sectors reserved for remotely piloted aircraft testing is in Alaska. Despite these robotic systems having great potential for persistence, wide-area sensing (if using multiple sensors in a "netted" approach), and use in potentially dangerous situations (e.g., before boarding a ship with a potentially hostile crew), weather and communications remain persistent problems, and more detailed concepts of operations may need to be developed as well.

Finally, satellites are as helpful for domain awareness and navigation as they are for communications. However, coverage at high latitudes can be limited due to degradation of functionality and the periodicity with which data are collected.

Challenges in the Ability to Respond to Incidents

Some of the most frequently asked questions at Workshops I and II were different variations of "How do we get there?" In several instances, conversation stalled on this point, if it had not already on the challenges related to awareness and communicating. When conversations moved

beyond "getting there," the question then became: "How do we do this once we get there?" In other words, participants felt challenged in illustrating how to move people and resources to the scene of a response and, once there, how to proceed with an effective response.

Response was a key element in a range of scenario events explored during Workshops I and II, where participants carefully weighed how an offshore oil rig in flames, ships involved in illicit trafficking, and a busy polar port, for example, could be reached for the purposes of rescue and environmental cleanup, law enforcement, and stewardship activities, respectively. The importance of response is highlighted in results from Workshop II. Many of the assets listed within "Tier 1" of Table 2.2 had to do with response, including MH-60 helicopters, airports and airfields, National Security Cutters, C-130 aircraft, the Rescue Coordination Center in Juneau, and the USCG Sector at Anchorage. The Polar Icebreaker Recapitalization Ship was also viewed quite favorably in the different breakout sessions.

Current enablers that can be potentially employed for a given Arctic response include cutters (the *Healy* and *Polar Star* icebreakers; National Security Cutters; medium-endurance cutters, such as the *Alex Haley*; high-endurance cutters, such as the *Munro*; patrol boats; and buoy tenders); aircraft, including fixed wing (e.g., the HC-130) and rotary wing (e.g., the MH-60, the MH-65); oil spill response equipment (e.g., spilled oil recovery systems, spill response equipment); the ports at Dutch Harbor and Nome; airports and airfields (at Deadhorse, Kotzebue, and Nome); a seasonal North Slope forward operating location; sites for pre-placement of response equipment; the USCG Sector at Anchorage; and the Rescue Coordination Center in Juneau. There are also international and national laws and regulations that theoretically guide behavior in the Arctic (and elsewhere) that could help control demand for USCG involvement, such as in rescue and fisheries management. Importantly, it cannot be assumed that any of the above enablers would necessarily be available or appropriate for a given response. It is also possible that other enablers could be available, including helicopters resident within the North Slope Borough for the purposes of SAR.

Why Is Response a Gap?

Even if communications and awareness were enhanced in the Arctic, a series of challenges would remain related to the ability to respond and execute operations in the region. Naturally, communications and awareness are also required for response, but the response gap is about a diverse set of challenges that limit ability to physically access the affected area and people and, once present, execute tasks associated with missions required for the response.[2]

[2] We did not examine the ability to access networks, except insofar as this is relevant to the communications gap. Currently, the limited size of the Arctic population and government presence, along with the prevalence of systems that are somewhat disconnected (though becoming increasingly connected) from broader networks and grids, make this issue somewhat less immediate than physical access, although planning should consider nonphysical networks.

Participants at Workshops I and II expressed concerns that maritime and aviation assets would not likely arrive on scene along a timeline meaningful for an effective response (e.g., before casualties are likely, or prior to a threat or hazard crossing international boundaries), especially if conditions were outside the peak of summer and involved areas not close to the coast. Another aspect of this was whether there would be sufficiently detailed plans ahead of time and an organizational nucleus to provide command, control, and coordination to ensure that people and assets were deployed rapidly and in the right combinations and order. Further, participants worried that once the assets were on scene, they would not necessarily be able to support all of the required response tasks because of a lack of ability to perform (or lack of proof of ability to perform) particular, specialized functions for which they were not originally designed to do. One example that came up at Workshop II was whether current icebreakers would be able to perform a wide range of law enforcement operations. Questions regarding the ability of existing platforms to respond to hazardous material spills and medical emergencies were also brought up at the workshops.

Further, the question of whether response could be sustained for the duration required was brought up several times. This involved both whether some response platforms would able to remain on scene long enough between refueling (or whether other platforms would be available to refuel assets mid-mission) and whether logistics could provide needed support over several days, weeks, or even months.

Finally, participants suggested that there was also a subgap with respect to defining or updating regulations to take into account new and potential future changes in the Arctic. Even if new regulations and guidelines continue to be outlined, participants wondered about the capacity of the USCG to recognize violations and address them.

In the future, participants wanted to see the following:

- the ability to move and sustain a small-to-moderately sized response force and resources to respond anywhere, anytime within the Arctic domain
- deterrence of incidents from occurring in the first place and location at the right place at the right time with the right equipment to resolve an issue in a timely way.

There is, once again, a capacity issue at play here. There are some cutters and aircraft, for example, that have been employed, sometimes regularly, in the Arctic during the summer season. However, as we will discuss below, these are few in number and hardly guaranteed to be close enough within the vast Arctic domain to respond to a given incident at a particular time. In other words, assets potentially available for Arctic response are “low density” (very few in number and potentially dispersed across locations far away from a scene) and potentially in high demand should a crisis occur.

Further, it appears that, although there are organizations that might fulfill the response coordination role (such as the USCG Sector at Anchorage), it is unclear whether such organizations are able to reserve sufficient time or resources to focus on planning responses to a

wide range of possible Arctic contingencies. Additionally, workshop participants expressed some uncertainty regarding which organizations would be in charge of which types of responses.

Another root cause of this gap is that many assets (with the exception of icebreakers) were not designed specifically for Arctic operations. Some, of course, could be better suited than others, but ability to operate in harsh weather and icy conditions is a persistent problem that workshop participants brought up frequently. Vast distances in the Arctic, along with the very low density of existing infrastructure to support operations and logistics, also challenge many assets in the Arctic.

Icebreakers appear to have the opposite challenge, in that these are not designed (at least up until now) to perform many functions besides breaking ice. They could be needed as coordination nodes for conducting law enforcement and oil spill response management in the future. Workshop participants raised concern that all potential Arctic response assets could be lacking in appropriate sensors, communications modes, and specialized response equipment (e.g., for law enforcement, oil spills, medical care), but that this issue had not been systematically reviewed in terms of requirements and risk level.

Possible Avenues for Remediation

Remediation will include the new Polar Icebreaker Recapitalization Ship but should likely focus on a portfolio of needs, acknowledging the ways in which response is or would be conducted in the Arctic region. A key consideration for all Arctic response is that it is inherently expeditionary, with a need for mobile assets that can help overcome the region's vast distances. Designing sets of platforms and deployable teams with an expeditionary mindset can enable mass evacuations, the provision of emergency medical care, and achievement of other essential missions in the region.

Given this, there could be a need for both agile, first response assets and infrastructure and logistics to sustain longer-term operations and (literally) conduct heavy lifting. Some aspects of a portfolio plan to mitigate the response gap could include creating additional detailed plans for various contingencies, developing remotely controlled airlift and oil spill response capability, adding small boat landing capability to icebreakers, increasing the number of forward operating locations and resources (including local and mobile elements), investing in lighter-than-air airships to move large loads or masses of people, and enforcing new industry self-help regulations.

Another important planning consideration is the availability of potential response assets that exist today to still be useful in the future as they approach the later stages of their operational lives. A portfolio approach should consider not only the need for new assets but also the need to maintain and replace (if still useful) existing ones that could include, for example, National Security Cutters.

At the same time, improving long-term relationships with native communities can also help make them more capable and more resilient, while also drawing on their detailed knowledge of

the environment. Designating liaisons and expanding USCG cultural training can aid in ensuring that all parties recognize the alignment of USCG goals with community interests. Such efforts can dovetail well with expanded training of native communities in prevention and response, along with prepositioning of key response items in those communities and select infrastructure development.

Finally, addressing all of the above issues (and, indeed, the other potential gaps) requires an update of the 2013 USCG Arctic Strategy, to provide greater specificity regarding how to achieve more-detailed goals than were enumerated in the initial document. Such an update can also provide a venue for further elicitation of ideas on how to make the USCG more capable of responding to the many challenges of the Arctic region.

Deficiency in the Articulation of Needs and Risks

All three of the gaps described above require articulation of particular needs and the risks associated with not closing the gap in order to develop any plans of action and secure potential funding to remediate current Arctic challenges. Although the USCG has been one of the most prominent U.S. voices in expressing Arctic challenges, this has not resulted in many concrete plans or bountiful funding for remediating gaps. This is likely due to the multitude of other priorities for the service, DHS, and the U.S. government.

Why Is the Articulation of Needs and Risks a Gap?

The USCG and DHS as a whole (along with a variety of partners) have had much difficulty in making progress toward addressing persistent Arctic challenges. Improving the USCG's capability as an institution to identify specific needs and risks, and finding compelling ways to articulate these, could help generate momentum for closing Arctic capability gaps. Three challenges stand out as particular subgaps in this area. First, it is difficult to systematically identify gaps—and detailed potential remediation measures—using a repeatable process that encompasses a wide range of possible future demands. Second, there have been only limited efforts to map the contributions of specific enablers to capabilities, bearing in mind the known or potential limitations of those enablers specifically for Arctic operations. Third, illustrating or summarizing risk quantitatively—in particular, in terms of the potential impact on human life, security, the economy, and the environment—has been an elusive goal. All three of these challenges would need to be addressed in order to construct more-compelling, specific arguments as to what needs to be done in the Arctic and why. Although the USCG cannot control its own funding for Arctic planning and operations, it can do more—with the right analytic processes and methods—to control the narrative surrounding needs and risks in the region.

Notably, this gap may represent a broader challenge experienced by USCG decisionmakers, planners, and operators, but we examined it only from the perspective of the Arctic. The impact of this gap may also be particularly intense for the Arctic compared with missions in geographic

regions that receive more national attention. At the heart of this is the need to raise awareness in ways that will compel action (or at least widely acknowledge risks), which has historically been challenging for the Arctic as it competes with other national priorities.

The origin of this gap appears to be multifold. First, there are some legacy processes in play that previously met strategic planning needs very well but may not be the right approaches for all avenues of planning in 2017. Strategic planning for future Arctic capabilities (and perhaps other areas) may benefit from new, more-structured methodologies that give formal treatment to the deep uncertainty that surrounds what the future might look like in order to move from characterizing and understanding the problem to systematically identifying gaps and solutions. Second, the lack of access to data and ability to fuse information identified in the context of the awareness gap is also problematic for communicating needs and risks. Showing through data analysis, rather than telling a narrative about how missions cannot be effectively conducted, may be more informative and compelling. Another aspect of this is the very limited (if any) access to computer simulation capability for the purposes of strategic planning. Computer simulations offer opportunities to study problems, outcomes, and solutions in cases where real-world data are not available because of either limited domain awareness (e.g., it is difficult to identify what fraction of dark vessels can be observed without knowing how many there were to begin with) or lack of opportunity to test (e.g., ability of helicopters to conduct various types of SAR operations).

Possible Avenues for Remediation

Workshop participants expressed a desire to robustly derive needs and associated risks at a level of detail appropriate for taking action, and to shape a compelling narrative around this information. This could be possible in the future by building additional structure and adding quantitative assessment capabilities to existing planning processes.

Adding some approaches to the assessments toolkit to include ways of robustly demonstrating present capabilities under new scenarios and risk is one way in which to consider remediating this gap. Improving the data environment to include automated data recording and transmission and better access to historical and multisource data sets will also better enable analysis for assessments. Continuing to bring together key DHS stakeholders will also be important, especially if work can be done to enable consistent information-gathering and tracking of gaps and monitoring their progress toward closure. Partners might also be included in certain discussions; for example, the Intelligence Community could be well sourced for characterizing threats that might be useful in USCG Arctic risk analyses. Finally, developing a regular schedule for updating plans and communicating risks may also be helpful.

4. Identifying Vulnerabilities Associated with Gaps

Identifying vulnerabilities associated with not closing potential gaps is a key element of communicating the importance of those gaps to decisionmakers. There are several ways in which vulnerabilities can be examined, including using quantitative approaches (e.g., statistical methods or simulations). Here, the research team used a straightforward, structured qualitative approach,= based on the relevance of USCG statutory missions to Arctic operations,= and the role of potential gaps described in Chapter 3 in inhibiting the conduct of these missions. We chose the approach described below because it focuses on what is known—that is, the missions the USCG is doctrinally organized, trained, and equipped to perform. These missions are not constrained by geographic area except (usually) by the boundaries of U.S. territory (unless the USCG is deployed elsewhere). In other words, the USCG should theoretically be able to perform all statutory missions in the Arctic; examining how potential gaps could interfere with these missions at northern polar latitudes tells us something about USCG mission vulnerabilities and the criticality of closing potential gaps by the 2030s.

More specifically, we estimated the degree of vulnerability of each USCG statutory mission resulting from the potential gaps by the 2030s with a qualitative rating scale. For each potential gap and mission, we examined three factors: (1) the applicability of the mission to the Arctic in 2017, which provides some sense of the immediacy with which any potential gaps could have impact; (2) the level of impact that mission failure could have on human life, security, the environment, and the economy; and (3) how well workshop participants suggested that assets available or planned in 2017 could address the gap for the mission in question. We arrived at four qualitative ratings by varying the intensity of the conditions outlined above and by combining them in different ways. This scale was designed such that any mission and potential gap combination could meet all three specific conditions within a particular rating.

- Critical
  - The mission type is already relevant in the Arctic based on developments and USCG activity in the region since 2008 (ten years before the publication of this report).
  - The mission outcome in the absence of the type of capability focused on in the gap could include the loss of human life, a prolonged security or economic crisis, or irreversible[1] environmental damage.
  - Workshop results suggest that the current assets providing the type of capability focused on in the gap are insufficient to cover the entire U.S. Arctic[2] 24-7-365.

[1] In the context of the next few decades.

[2] As defined in Figure 1.1.

- Important
  - The mission type is already relevant in the Arctic based on developments and USCG activity in the region since 2008.
  - The conduct of the mission in the absence of the type of capability focused on in the gap could be severely delayed, resulting in temporary, largely reversible impacts to people, the economy, national security, and the environment.
  - Workshop results suggest that the current assets providing the type of capability focused on in the gap could be insufficient to cover the entire U.S. Arctic[3] 24-7-365.
- Potential
  - The mission type may be relevant in the Arctic by the 2030 decade, based on the futures discussed in Workshop I (see Appendix C).
  - The mission outcome in the absence of the type of capability focused on in the gap could include the loss of human life, a prolonged security or economic crisis, or irreversible[4] environmental damage.
  - Workshop results suggest that the current assets providing the type of capability focused on in the gap could be insufficient to cover the entire U.S. Arctic[5] 24-7-365 in the 2030 decade.
- Minimal
  - The mission type is unlikely to be relevant in the Arctic by the 2030 decade, based on the futures discussed in Workshop I (see Appendix C).
  - Whether the potential capability gap could have an impact on the mission is unclear.
  - Workshop results are inconclusive about whether current assets providing the type of capability focused on in the gap would be sufficient to cover the entire U.S. Arctic[6] 24-7-365 in the 2030 decade.

Table 4.1 provides a summary of our assessment of the relationship of potential gaps to each statutory USCG mission according to the scale presented above. Once again, all three conditions comprising each rating had to be met in order to achieve a particular end result. For each gap and mission pairing, we assumed that all other gaps were closed in order to examine the unique relationship between each gap and statutory mission. It should also be borne in mind that the absence of the capability described in the gap refers only to the difference between what is available today (2017 level of capability) and what Workshop II participants articulated was desired for the future. Finally, we also assumed that the 2017 level of capability is available in the 2030 decade, which is why, for some missions, there is a critical gap in one area whereas, for others, the same gap is considered important but not critical (i.e., remaining at current levels of

[3] As defined in Figure 1.1.

[4] In the context of the next few decades.

[5] As defined in Figure 1.1.

[6] As defined in Figure 1.1.

capability in the future could more drastically impact some missions than others because of the nature of the missions themselves).

Table 4.1. Level of Vulnerability Associated with Not Closing Possible Capability Gaps by the 2030s

Mission Category	Mission	Communications	Awareness	Response	Needs and Risks
Safety	Search and rescue	**Critical**	**Critical**	**Critical**	**Critical**
	Marine safety	**Critical**	**Critical**	**Critical**	**Critical**
Security	Ports, waterways, and coastal safety	Important	Important	**Critical**	**Critical**
	Drug interdiction	Potential	Potential	Potential	Important
	Migrant interdiction	Potential	Potential	Potential	Important
	Defense readiness	Important	Potential	Important	Important
Stewardship	Aids to navigation and waterway management	Important	Important	Important	Important
	Ice operations	**Critical**	**Critical**	Important	**Critical**
	Living marine resources	Important	Important	Important	Important
	Marine environmental protection	Important	**Critical**	**Critical**	**Critical**
	Other law enforcement	Potential	Potential	Potential	Important

As shown in Table 4.1, we did not assess any possible capability gaps as minimal because the USCG is conducting or is at-the-ready to conduct most of these statutory missions in the Arctic today. Those that seem further along the horizon, such as migrant interdiction, cannot be discounted as potential future missions at this stage given our examination of future factors presented in Appendix A and discussions at Workshop I (see Appendix C).[7] It is important to consider that the USCG statutory missions can be changed, and any analysis of gaps should be updated if this occurs.

For this assessment, the "Needs and Risks" gap was deemed *critical* if at least one other gap for a particular mission was *critical*, and was deemed *important* if other gaps for a particular

[7] We did not examine the likelihoods of different futures but did focus on what are plausible alternatives to a continuation of current trends, given actors and issues that are known today.

mission were labeled with *important*, *potential*, or both. This is because not enhancing the articulation of needs and risks associated with a critical gap and mission combination could stagnate efforts to close the gap itself. Those gap-mission intersections that were not deemed critical are nonetheless important to monitor to inform progress on closing the overall gap. Assessing needs and risks is also essential for determining if and when a *potential* gap-mission intersection graduates to *important* or *critical*.

For the two missions in the category of safety, we considered all the gaps to be *critical*. Not only is the USCG concerned about conducting these missions in the Arctic today, but there is a clear potential for loss of life and property and introduction of environmental hazards.

Within the security category, both drug and migrant interdiction were considered missions with primary relevance in some years hence. Thus, all gaps were labeled *potential*, with the exception of the articulation of needs and risks, per our criteria outlined above. In contrast, there is some limited maritime commercial activity in the Arctic today, which is why we labeled gaps for the ports, waterways, and coastal safety mission as either *critical* or *important*. Only having the capability of current communications and awareness assets available in the 2030 decade would probably not threaten life or national security in this case because of the nature of the mission and the needs associated with the mission. However, response assets are either slow or too far away to respond quickly under many circumstances, which is why this particular intersection was labeled as *critical*. Should a deepwater port be established in the Arctic, these gaps will all rise to the level of critical because of the increased potential for activity, not to mention the baseline responsibilities associated with managing a large port, which the USCG and other DHS components would likely bear at least some, if not the large portion of, shouldering those responsibilities.

Communications and response gaps associated with defense readiness were labeled as *important* because we anticipate that these might impact the USCG's ability to conduct peacetime engagements, which is important for national security, among other things. Other aspects of defense readiness that might require enhanced domain awareness capabilities, such as maritime intercept operations, do not seem immediately relevant in the Arctic but could become so under some of the futures that participants in Workshop I saw as plausible (see Appendix C for more details on these futures). For this reason, the awareness gap associated with defense readiness is labeled as *potential*.

Finally, possible communications, awareness, and response gaps associated with four of the five stewardship missions were assessed as *critical* or *important* because they are all quite active Arctic mission areas in 2017. All of the gaps associated with aids to navigation were considered *important*, rather than *critical*, because there are limited resources for this mission available today, which are, perhaps, minimally effective in keeping the relatively small number of vessels in the region navigating without major incident. Moderate future increases in vessel traffic, especially involving any illicit activity (by more "dark vessels" that are not cooperatively

engaging in safe navigation and may be less risk averse than other vessels), would probably raise the awareness gap for aids to navigation—and possibly the others—to a level of *critical*.

With respect to ice operations, there is insufficient knowledge about fast-changing local conditions and ability to communicate this information in order to ensure safety, which is why the communications and awareness gaps were labeled as *critical* for this mission. With the icebreakers *Healy* and *Polar Star* (the latter is to be replaced), there is some icebreaking response capability available, but this gap is still an *important* vulnerability with respect to the ice operations mission. Whether this amount of icebreaking capacity will be sufficient to conduct this mission in the future depends on the intersection of changes in ice conditions and economic and other activity in non-summer months.

Marine environmental protection is something the USCG is concerned with everywhere today. Limited communication regarding incidents could slow response and cause damage, but even more concerning is the ability to have awareness of the location and scope of the problem, and be able to get the right assets and people on scene in time. Thus, we concluded that the awareness and response gaps are *critical* for this mission, and the communications gap is *important*.

The USCG also has very active responsibilities for its living marine resources mission with respect to fishing in the Bering Sea (one of the richest fisheries in the world), which is included within U.S. Arctic territory, according to the more expansive definition of the Arctic used in this report. However, fishing is not presently permitted within the highest northern latitudes in the U.S. EEZ, where the challenges associated with the potential gaps identified are, in some respects, greater in magnitude. Thus, the impact of potential gaps for this mission were considered *important*, rather than *critical*.

Finally, the other law enforcement mission has much to do with fisheries enforcement, at least for now. Although this is certainly important within the Bering Sea, we assessed communications, awareness, and response gaps as having *potential* future importance because of the uncertainty associated with two factors: whether fishing in the highest northern latitudes of the U.S. EEZ will become legal and whether vessels conducting illegal fishing activities can safely access this region in large numbers. Should the fishing ban be lifted or a greater number of vessels be suspected of illegal fishing, these gaps could very quickly rise to the level of *critical* for this mission and should therefore be carefully minded. The importance of these gaps could also increase should other types of illegal activity increase in the future Arctic. Domain awareness will be important for determining whether demand for this mission could rise.

5. Conclusions and Recommendations

To the extent that levels of activity in the Arctic increase by the 2030s and beyond, the USCG will likely face increasing demand to conduct missions that it already performs in the Arctic, and potentially may find itself required to conduct additional missions in the region. Current capability gaps—which may be exacerbated by increased demand for USCG missions in the Arctic—include extremely limited voice and data communications; lack of persistent awareness of threats and hazards across the vast region; and limited means to conduct a timely, organized, and sustained response to a wide spectrum of possible incidents. A fourth, institutional gap is the presence of inadequate means to articulate Arctic needs and risks to decisionmakers. These potential gaps were derived from insights gathered from two structured workshops in May and September 2017, as well as other research activities described in the appendixes.

Several key findings arose from this research, as follows:

- An unexpected finding was that **icebreakers were perceived as less critical to a number of scenarios than might have been expected.** Icebreakers are important for creating accessibility for other vessels, but their slow speed of advance and their relative scarcity mean that it is unlikely that one will be near enough to any given contingency to provide decisive support in the limited amount of time available. While expanding the polar icebreaker fleet from its current size of two vessels (one medium and one heavy) would reduce this scarcity, it would not abolish it. Given the extent of public attention that has been focused on the need for icebreakers, some participants seemed surprised as they worked through problems and found that icebreakers were not always central to addressing response needs. Overall, participants seemed to indicate that although icebreakers are *necessary* under many circumstances for safely accessing the Arctic, they are *not sufficient* for enabling mission execution in the region.
- **Icebreakers need to be complemented by other types of assets.** Some of these capabilities will derive from **increased forward basing** in the region, which, in particular cases, could be extended year-round or include mobile options. Key logistical enablers include **fixed-wing and rotary-wing aircraft**. Additional rotary-wing aircraft in combination with cutters would also expand incident response capability in the region.
- Further, we found that there was a **critical need for domain-awareness technology and communications capabilities** articulated in the workshops. This was not surprising, given the scarcity of sensors and communications networks in the region, but the frequency with which these types of assets were invoked for disparate scenarios was striking. The need to integrate information from disparate sources to be able to achieve a common operating picture was also emphasized.
- The **primacy of partnerships** was another key finding from the workshops. This is not a new idea (e.g., this was indicated as important in the 2013 *Coast Guard Arctic Strategy*). The importance of cross-agency collaboration was underscored on numerous occasions during the course of the workshops. All agencies have limited capabilities and capacities

in the region, so finding ways in which to leverage others' strengths was a recurring theme in multiple scenarios. Naturally, federal, state, local, tribal, international, and private-sector partners all have different procedures and communications channels; they also may not understand what others have to offer. Collaborative planning, tabletop exercises, and live exercises can help overcome these issues.

- Central to all of these findings is the **need to communicate them along with implications** for USCG and wider DHS operations in the Arctic. **Updating the 2013 USCG Arctic Strategy** to provide greater specificity regarding how to achieve more-detailed goals than were enumerated in the initial document will also help guide next steps for closing potential gaps in the region. Such an update can also provide a venue for further elicitation of ideas on how to make the USCG more capable of responding to the many challenges of the Arctic region.

The USCG and DHS are in a difficult position when it comes to planning for Arctic operations. The Arctic environment includes numerous hazards and potential threats across a vast, harsh operating environment with extremely limited infrastructure and assets; the scale of these threats may increase in tandem with activity in the region. One workshop participant bluntly talked about waiting for a crisis to happen in the Arctic before strategy, policy, and investments would catch up to the potential needs for crisis management in the region.

In the previous chapters, we highlighted four major possible capability gaps and their components, as well as how they present vulnerabilities to USCG statutory mission areas. The USCG is not at liberty to elect where it is called upon to conduct these statutory missions, and hence must be prepared to perform them in the Arctic. Yet the USCG—at least in the context of the Arctic scenarios examined in this report—is underprepared and underresourced for conducting this work in the region. We recommend four steps to continue building momentum in an effort to expand ability to operate in the Arctic and reduce the vulnerabilities of missions in the region.

First, **DHS should spearhead more-extensive planning and exercising for response in the Arctic** than at present. While the USCG is a central player in the Arctic and will likely play a central role in many possible contingencies, others also need to be involved, including other DHS components. Given the paucity of assets and the vast, extreme environment, response to any substantial contingency needs to employ the strengths of diverse actors. To make this collective response effective, the actors need to not only plan together but exercise their capabilities in both tabletop and live exercises that improve their interoperability and minimize seams between them.

Second, **the USCG should continue research for Arctic CAR development to support the development of materiel and nonmateriel approaches for closing the gaps** identified in this report and previous efforts. Importantly, the CAR should stress the presence of capability gaps even given the acquisition of a new heavy icebreaker, which will facilitate an important but incremental step up in capability, given that it will ultimately replace an older icebreaking vessel. The gaps and requirements highlighted in the CAR should drive the USGC to develop a detailed

roadmap for future action with respect to strategy, planning, and acquisition tasks to support the improvement of Arctic capabilities—separately, or as part of the CAR, if applicable—to ensure that these processes do not stall following the submission of the CAR and to provide continuity of action over coming years. In conjunction with CAR development, **the USCG should also continue reviewing requirements for the Polar Icebreaker Recapitalization Ship** to ensure the applicability of this vessel to a potentially multimission environment. Features that should be carefully evaluated include command, control, and communications capabilities, along with crew space, to enable use of the cutter as an element to enable mobile sector operations in Arctic response; an MH-60 or other helicopter landing and refueling capability; law enforcement enablers, such as small boat landing ability; capacity to carry small unmanned systems for surveillance and ability to ingest and fuse their information feeds with other sources of information; additional environmental hazard and medical equipment; and other multimission equipment and sensors, including those that might be applicable for future defense readiness missions.

Finally, a forthcoming Arctic CAR could suggest gaps that will cause the USCG to **review and update its Arctic strategy, as well as develop related plans for implementation and specific concepts for different types of response**. These response plans should be practiced in tabletop and live exercises (among other training methods) in order to ensure readiness (with partners, including local communities) under a variety of circumstances. It is important to remember that improvements to Arctic capabilities are a multipartner effort that involves a portfolio solution, including both materiel and nonmateriel assets of various types. The Arctic region will always be a challenging one in which to operate, with vast distances, harsh conditions, sparse infrastructure, and limited assets. In the context of this environment, it will remain critical to leverage the collective capabilities of partner agencies at the international, federal, state, local, tribal, and private-sector levels. The ultimate goal will be to close gaps before any major Arctic crises necessitate action.

Appendix A. Scenario Development Approach

This appendix describes the approach we developed to create scenarios used in the workshops. There are several alternative illustrations of the future that might be worth considering, and many dimensions along which the Arctic could experience meaningful change by the 2030s. We took the perspective that the main point of examining scenarios is not to arrive at a single prediction of the future, but rather to consider multiple alternative future conditions that are helpful in understanding risk so that decisionmakers can make informed planning choices. We also wanted to design an inherently flexible framework for scenarios so that anyone using them could create a variety of scenarios using our toolkit.

Here, we discuss our derivation of an original approach to scenario building that involves two elements—futures and events—that can be combined in different ways to produce various scenarios. These scenarios may be updated as planning needs change. Our method expands on the common two-by-two matrix approach, in which different states of two individual factors, or driving forces, are used to develop four scenarios.[1] It is designed to emphasize that more than just two factors can shape any given future state—and thus the outcome of any scenario-based planning exercise. It exposes the interdependencies of factors that may influence the type and level of capability needed to respond to an incident or to changing conditions in a future world. The method also produces alternative futures without resorting to a low/medium/high-risk approach, which often leads planners to arbitrarily select the middle of the road as the most likely future. This approach provides more-robust analysis than might otherwise be performed with a simple matrix approach.

In the following sections, we describe our methodology for creating scenarios, beginning with a description of futures development, including the set of future factors from which futures are developed and several future state narratives, followed by several events.

[1] The two-by-two matrix approach for generating scenarios was popularized by the strategy consulting firm Global Business Network in the late 1980s and early 1990s. This matrix approach narrows a set of identified driving forces to two "critical uncertainties" by ranking these forces according to two criteria: (1) the degree to which it is important to the focal issue and (2) the degree of uncertainty surrounding the forces. Then, the identified forces are placed on an axis of uncertainty, which represents the continuum of possibilities between two extremes. For example, if the economy is a driving force for a given focal issue, the axis of uncertainty would represent all the possibilities between a weak and a strong economy. When the axes for the two driving forces are crossed, a simple two-by-two matrix is formed from which four scenario narratives can be developed, one for each quadrant of the matrix. For additional details, see Thomas J. Chermack, *Scenario Planning in Organizations: How to Create, Use, and Assess Scenarios*, San Francisco, Calif.: Berrett-Koehler Publishers, Inc., 2011.

Futures Development

Using our method, scenarios are developed by combining different *futures* and stressing *events* into one narrative. A future describes the general state of the world and provides a backdrop for which a stressing event may occur. An event describes a stressing incident or series of incidences that require a USCG, and more broadly, a DHS response. We discuss events in more detail later in this appendix.

Futures are composed of narratives from each factor within our *future factor* set. We adapted our set of future factors from the PMESII-PT framework, outlined in the Army Doctrine Reference Publication (ADRP) 5-0: *The Operations Process*, and from the team's subject-matter expertise.[2] We include only factors (and elements of each factor) that were deemed pertinent to Arctic operations. Table A.1 provides descriptions for each factor used for building futures included in this analysis. Our methodology enables planners to rapidly generate large numbers of futures for scenario-based planning discussions because the futures are derived from common building blocks.

Table A.1. Future Factor Descriptions

Factor	Description
Geopolitics and international security	Describes the international security environment, including the distribution of power and formal and informal governance structures.
Domestic safety and security	Describes territory, state, and local politics and law enforcement forces and functions.
Economic	Describes the behavior and activity levels of producing, distributing, and consuming resources.
Social	Describes demographics, culture, beliefs, and behavior of society members.
Infrastructure (fixed)	Describes permanent infrastructure supporting basic community needs and economic, safety, and security functions.
Infrastructure (mobile)	Describes temporary and mobile infrastructure supporting basic community needs and economic, safety, and security functions.
Physical environment	Describes physical environment conditions, including geography, weather, and climate.
Policy and regulatory environment	Describes the regulatory environment of economic, maritime, immigration, and environmental activity.
Technology[a]	Encompasses the role of technology in industry and infrastructure.

[a] We recognize that technology can play a role in several, if not all, future factors included in this set. In this analysis, we limit technology to its role in industry and infrastructure because we see these as big driving forces in future capability needs and development.

[2] Headquarters, Department of the Army, *Doctrine Reference Publication No. 5-0: The Operations Process*, Washington D.C., May 17, 2012.

Future State Narratives

For each future factor, we developed at least two plausible, yet challenging, future states based on information from the literature and the team's subject-matter expertise (Table A.2). In each case, we included one future state that represents a continuation of present trends (Future State A), along with Future State B, which illustrates a more radical, yet plausible, change based on known actors and issues in 2017. A third future state (Future State C) was included when there was more than one direction of change that would result in a plausible departure from present trends.

Table A.2. Future States

Factor	Future State A	Future State B	Future State C
Geopolitics and international security	Stable governance and cooperation punctuated with occasional tensions	Increasing tension and conflict, NATO asserts presence in Arctic	
Domestic safety and security	Stable local cooperation and partnerships	Local community instability, increasing criminal activity	
Economic	Modest increase in economic activity	"Boom" across the Arctic	
Social	Small increase in seasonal workforce	Mass migration into the Arctic to support industry	Mass migration as a result of security conditions elsewhere
Infrastructure (fixed)	Limited infrastructure investment, planning efforts still under way	Private and government investment in infrastructure to support industry	Rapid increase in DoD infrastructure investment
Infrastructure (mobile)	No new assets are procured	Arctic assets become a priority for government investment	
Physical environment	Modest warming, impacts differ across the Arctic	Rapid climate change	No change from today
Policy and regulatory environment	Low tolerance for environmental impact, uncertainty in other areas	Environmental regulations loosened, legal immigration prioritized	
Technology	Technology progresses, no silver bullet	Advances lead to all-weather drilling capability	

NOTES: NATO = North Atlantic Treaty Organization. Future states are derived from Arctic Council, 2009; Emily Stromquist and Robert Johnston, *Opportunities and Challenges for Arctic Oil and Gas Developments*, Washington, D.C.: The Wilson Center, 2014; Olga Oliker, "Refusing a Cold War," *The National Interest*, July 28, 2016; Pezard et al., 2017.

Future State A: Stable Governance and Cooperation Punctuated with Occasional Tensions

Arctic governance is stable and cooperation among nations is resilient. Occasional tensions arise over waterways and continental shelf claims but are resolved peacefully to maintain a positive environment for economic growth. Concerns within U.S. leadership and among U.S. allies over the Russian military buildup from a decade ago have subsided, as Russia has continued to be an active, cooperative participant in Arctic matters. Other nations that previously announced intentions to increase defense spending and increase troop levels in the Arctic in response to Russian military activity have withdrawn from those efforts. However, both Russia and the United States maintain a military presence, consistent with 2017 levels, in the Arctic.

The Commission on the Limits of the Continental Shelf recently provided recommendations that settle the Russian, Danish, and Canadian submissions to extend their respective continental shelves. The commission recommendations indicate that the scientific evidence provided by all three submissions validate each claim, including areas of overlap of the Lomonosov Ridge and the Alpha-Mendeleev Ridge. With these recommendations, the three countries begin formal negotiations to delimitate their respective continental shelves. The United States still has not acceded to the convention.

Transnational criminal activity increases slightly as it becomes easier to smuggle drugs and conduct human trafficking by taking advantage of elevated levels of economic activity in the Arctic. But the Arctic is positioned to become an arena for effective international anticrime partnerships and coordination, with Arctic anticrime task forces effectively coordinating to monitor and deter large-scale criminal organizations.

Future State B: Increasing Tension and Conflict, NATO Asserts Presence in the Arctic

International tensions rooted elsewhere in the world stoke Arctic territorial disputes, including over waterways and outer continental shelf claims. The strength of cooperation among Arctic nations is challenged, threatening, for the first time, the stability of Arctic Council governance. This uncertainty opens avenues for non-Arctic states that seek to exert influence on Arctic matters through bilateral relationships with different countries and with indigenous populations. Taking advantage of unstable Arctic cooperation, transnational criminal activity increases dramatically.

Complicating matters, NATO allies reassert a need for military presence in the Arctic to keep continuing conflicts in the Middle East from turning into proxy wars. Russia and Canada do not support a role for NATO in the Arctic, and Russia ramps back up its military buildup that had stagnated in the previous decade. While the Arctic has managed to stay conflict-free to this date, there is increasing concern within U.S. leadership over security and control of sea lanes in the Arctic, and the United States ramps up military-related infrastructure investment.

Domestic Safety and Security

Future State A: Stable Local Cooperation and Partnerships

Local communities play an important role in supporting responsible and sustainable economic development in the Arctic. Indigenous groups are generally supportive of development activities as a means to improve economic and social conditions in their communities. Partnerships between indigenous groups and local law enforcement are strong, often serving as extensions of law enforcement in areas where government resourcing is low.

In areas where seasonal workforce populations grow, a marginal increase in local criminal activity is observed. Crimes include drug- and alcohol-related offenses, violence, and property damage. However, due to the harsh environment and challenges of setting up drug smuggling or human trafficking networks in the remote Arctic regions, large-scale criminal activity of this nature in the Arctic still lags behind relative crime rates in the continental United States. Nevertheless, increased monitoring and presence is required to deter opportunist criminals.

Future State B: Local Community Instability, Increasing Criminal Activity

As security at the southern border increases, the relatively unpopulated and undermonitored Arctic border becomes a new route for drugs smuggling, human trafficking, illegal migration, and criminal activity. Transnational criminal organizations have promised economic incentives to the local population, and partnerships between indigenous groups and local law enforcement are weak, preventing effective law enforcement in areas where government resourcing is low. Drugs and human sex trafficking are both on the rise in the Arctic as population and economic activity in Alaska increases.

Economic

Future State A: Modest Increase in Economic Activity

Relatively consistent economic conditions over the previous decade result in a modest increase in shipping via the Arctic, as well as some increase in resource extraction both onshore and offshore. Global demand for hydrocarbon resources has increased in tandem with population growth, but for much of the Arctic, hydrocarbon exploration and extraction is still very expensive, which tempers development in the Arctic. There is increasing global demand for fish, particularly in Asia. Fish stocks have moved farther north into Arctic waters, driving an increase in legal and illegal fishing vessels in sub-Arctic and Arctic waters. Enforcement of fishing bans on the high seas remains a challenge.

The Arctic Ocean is seasonally accessible for all practical purposes. Cargo ships and tankers transit the Northern Sea Route and the Northwest Passage. New shipping routes are being forged. Tourism continues to increase slowly as insurance companies restrict cruise line expansion to fully ice-free regions and seasons and require tandem cruising with self-rescue capabilities.

Future State B: "Boom" Across the Arctic

Rapid technological advancement and increasing demand for Arctic resources, including fish, hydrocarbons, and minerals, greatly increase the extent of economic activity in the Arctic. Commercial shipping increases substantially to accommodate both resource extraction and population growth. Moreover, trans-Arctic shipping grows exponentially, reflecting the fuel savings associated with shorter routes and political or military crises that jeopardize or close key routes elsewhere.

The Arctic Ocean is seasonally accessible for all practical purposes. Both cargo ships and tankers transit the Northern Sea Route and the Northwest Passage. Tourism grows exponentially, but international adherence to safety standards by companies in non-Arctic nations is spotty. International coordination and agreements for navigational safety, pollution response, and SAR move forward smoothly, but there are some questions as to whether all of the nations involved have the capabilities required by the agreements. Increases in individual adventurers and kayaktivists protesting oil extraction in the Arctic pose challenges for SAR as economic activity increases.

Social

Future State A: Small Increase in Seasonal Workforce

The Arctic population rises slightly as people come to the region to support new seasonal industry activity, but population growth is circumscribed by infrastructure challenges caused by increased storm intensity, rising seas, and thawing permafrost. The remoteness of the Arctic and limited law enforcement resources make implementing and enforcing immigration laws challenging. Local communities have increased domestic unrest because of the uncertainty in economic and regulatory environments. Evacuations related to increased storm intensity, rising seas, and thawing permafrost are increasing in number, causing local support and resources to be unreliable.

Future State B: Mass Migration to Support Industry

The Arctic population sharply rises, with extremely large seasonal spikes, as people migrate to the region to support new industry activity. The increase in population further stresses resource scarcity in the Arctic. Infrastructure is built rapidly but not with longevity in mind. Immigration regulations are generally more restrictive, but the number of illegal immigrants in the United States has not changed, as legal immigration through guest worker programs is prioritized. People come to work in the United States legally, specifically in booming industries in the Arctic, but more people overstay their visas, posing challenges for immigration enforcement. Local communities protest the guest worker programs because they feel immigrants are taking their jobs. Local communities also protest the environmental damages caused by increased development in the area. Increased storm intensity, rising seas, and thawing

permafrost all create infrastructure challenges for population growth, but favorable economic conditions provide motivation for infrastructure investment by industry.

Future State C: Mass Migration as a Result of Security Conditions Elsewhere

The Arctic population rises sharply as security conditions in some countries force large populations to flee. Changes in land and maritime access allow people to move more freely across the Arctic. The increase in permanent population further stresses resource scarcity in the Arctic, and increased storm intensity, rising seas, and thawing permafrost all create infrastructure challenges for sustaining population growth. With the resource scarcity comes a rise in criminal activity and conflicts between local communities and recent transplants. There is political pressure to welcome refugee communities from the continental United States, but local communities react with hostility toward the newcomers.

Infrastructure: Fixed

Future State A: Limited Infrastructure Investment, Planning Efforts Still Under Way

Under the Arctic Council, a transportation infrastructure working group has been working to develop a comprehensive transportation infrastructure plan that includes roadways, waterways, and airport infrastructure, among other modes, for access to and from the region. However, uncertainty about environmental, economic, and geopolitical conditions still poses challenges in completing the plan. The plan is projected to cost billions. Government funding is seen as a must to kickstart construction, as private investors are wary of uncertain conditions.

Much of rural Alaska still lacks basic utility infrastructure. Broadband internet has been enhanced across the state as a result of private investment.

Future State B: Private and Government Investment in Infrastructure to Support Industry

Under the Arctic Council, the transportation infrastructure working group successfully develops a comprehensive transportation infrastructure plan. Several Arctic nations have already begun to implement parts of the plan, although it is still not expected to be complete until the late 2030s. Fortunately, increased economic development leads private companies to also develop long-term infrastructure plans for making access to the Arctic easier, safer, and less expensive. In 2029, the United States completed construction on the last leg of an 800-mile natural gas pipeline from the North Slope of Alaska to Nikiski, where the gas is chilled into liquefied natural gas and shipped on tankers. Additionally, a new road that runs from Utqiagvik through the National Petroleum Reserve to Nuiqsut has been built, although road maintenance continues to be challenging in thawing permafrost zones. Basic sewer and water infrastructure has been built in some rural Arctic Alaska areas in preparation for the relocation of native villages with severe coastal erosion.

Although some infrastructure development is hindered by increased storm activity, coastal erosion and sea level rise, and melting permafrost, the economic boom in the area justifies the expenses of building for long-term resilience.

Future State C: Rapid Increase in DoD Infrastructure Investment

Increased military activity among Arctic nations leads to rapid infrastructure development by DoD. Although the infrastructure improves supply chains and allows for ease of transport, the infrastructure is primarily focused on DoD requirements, is restrictive for local communities, and hinders economic development as large swaths of land and water are secured for military use.

Infrastructure: Mobile

Future State A: No New Assets Are Procured

Known requirements for investment in icebreakers, ships, helicopters, and fixed-wing aircraft continue to be tough to fund in a constrained budget environment. Federal law enforcement must continue to rely on existing local assets, and international SAR requirements are not met.

Future State B: Arctic Assets Become a Priority for Government Investment

As the Arctic becomes more accessible, icebreakers, ships, helicopters, and fixed-wing aircraft are priority investments. This is justified both by international agreements the United States has signed (e.g., to conduct Arctic SAR within particular boundaries) and by the increased USCG mission requirements resulting from growing traffic and industry in the region.

Physical Environment

Future State A: Modest Warming, Impacts Differ Across the Arctic

The climate warms moderately, resulting in reduced duration of sea ice presence, delayed timing of land deep freeze, and increased duration and areas of permafrost thaw. These physical patterns result in changes to land and sea access in the Arctic. Maritime access increases unevenly across the Arctic, which affects individual shipping routes differently and causes the shipping industry to view the Arctic as an inconsistent and unreliable investment. The Bering Strait is open from late May to early December, with a ten-week shoulder season (five weeks on either side). The Northwest Passage is essentially ice-free for five weeks, with a six-week shoulder season (three weeks on either side). The Northern Sea Route is essentially ice-free for nine weeks, with a ten-week shoulder season (five weeks on either side), and the transpolar route is open for six weeks, with a ten-week shoulder season (five weeks on either side).

On land, there is increasing coastal erosion, shorter duration of ice road availability, loss of soil support, fluctuations in land surface height, increased flooding, and increased risk of liquefaction during earthquakes.

Future State B: Rapid Climate Change

The climate warms rapidly, resulting in reduced duration of sea ice presence, delayed timing of land deep freeze, and increased duration and areas of permafrost thaw. These physical patterns result in changes to land and sea access in the Arctic. Maritime access increases dramatically across the Arctic, which causes the shipping industry to begin to view the Arctic as a more reliable investment. The Bering Strait is open from April through December, with a ten-week shoulder season (five weeks on either side). The Northwest Passage is essentially ice-free for ten weeks, with an eight-week shoulder season (four weeks on either side). The Northern Sea Route is essentially ice-free for 12 weeks, with a ten-week shoulder season (five weeks on either side), and the transpolar route is open for eight weeks, with a ten-week shoulder season (five weeks on either side).

On land, coastal erosion is severe, causing many communities to need to be relocated. There is a much shorter duration of ice road availability. The loss of soil support, fluctuations in land surface height, flooding risk, and increased risk of liquefaction during earthquakes pose significant challenges for infrastructure.

Future State C: No Change from Today

Investments in the 2020s in decarbonization technologies, such as carbon capture and storage, energy efficiencies, and shifts to more-renewable sources of energy, result in immediate reductions in greenhouse gas emissions, mitigating some impacts of climate change. Additionally, two very large volcanic eruptions in Japan and Italy in the past year caused a mild cooling effect, as these particles shaded the planet from incoming solar radiation. As a result, the climate and physical environment looks much like it did in 2017.

Policy and Regulatory Environment

Future State A: Low Tolerance for Environmental Impact, Uncertainty in Other Areas

There remains low tolerance for environmental impact, shipping standards and routes are still being developed, and there are uncertainties in other areas of the regulatory environment, which somewhat tempers overall economic growth and challenges agencies with regulatory responsibilities as they strive to enforce laws and regulations. The International Maritime Organization continues to revise and refine the Polar Code as the environment changes and technology advances, but it is criticized by environmental nongovernmental organizations for not having strict enough regulations. There is uncertainty that compliance with regulations will be met given low government resourcing levels. Immigration policies are generally restrictive.

Future State B: Environmental Regulations Loosened, Legal Immigration Prioritized

Arctic nations relax environmental regulations, which lowers barriers to entry and dramatically increases the number of industry players in hydrocarbon and mineral extraction and fishing. Environmental activists ramp up activities, and the region faces high levels of media

attention because of the rapid development and conflicts with environmentalists. Legal immigration is prioritized for those looking to live in or move to the north to promote economic development. The International Maritime Organization continues to revise and refine the Polar Code as the environment changes and technology advances, but it is criticized by environmental nongovernmental organizations for not having strict enough regulations. Agencies struggle with regulatory responsibilities and law enforcement, and they strive to enforce laws and regulations in the context of new economic, security, and social conditions.

Technology

Future State A: Technology Progresses, No Silver Bullet

Technology progresses steadily, but there are no economic booms as a result of technological advances. Unpredictable weather conditions and incremental advances in communications systems and other navigational aids still pose challenges for mariners and resource extraction. Technology to address the changing environment (e.g., permafrost melt, storm resiliency) is slow to develop.

Future State B: Advances Lead to All-Weather Drilling Capability

Advances in vessel design and operation leads ice-capable or all-weather drilling capabilities. This technology allows for a boom in hydrocarbon extraction in the Arctic. Regulations have not kept pace with the technological advances, and environmental protests in the Arctic increase.

Examples

Two examples of how scenario factors were varied to create different future states are included in Tables A.3 and A.4.

Table A.3. Scenario Factor Summary for "Increasing Disorder" Future

Scenario Factor	Future State
Physical environment	Modest warming, impacts differ across the Arctic
Economic	Modest increase in economic activity
Technology	Technology progresses, no silver bullet
Policy and regulatory environment	Environmental regulations loosened, legal immigration prioritized
Domestic safety and security	Local community instability, increasing criminal activity
Geopolitics and international security	Increasing tension and conflict, NATO asserts presence in Arctic
Social	Mass migration as a result of security conditions elsewhere
Infrastructure (fixed)	Rapid increase in DoD infrastructure investment
Infrastructure (mobile)	Arctic assets become a priority for government investment

Table A.4. Scenario Factor Summary for "Structured Boom" Future

Scenario Factor	Future State
Physical environment	Modest warming, impacts differ across the Arctic
Economic	"Boom" across the Arctic
Technology	Advances lead to all-weather drilling capabilities
Policy and regulatory environment	Low tolerance for environmental impact, uncertainty in other areas
Domestic safety and security	Stable local cooperation and partnerships
Geopolitics and international security	Stable governance and cooperation punctuated with occasional tensions
Social	Mass migration into the Arctic to support industry
Infrastructure (fixed)	Private and government investment in infrastructure to support industry
Infrastructure (mobile)	Arctic assets become a priority for government investment

Events

The second element that makes up a scenario is a stressing event. We derived several sample events from exploration of diverse possible threats in the Arctic, corroborated by historical events that have occurred either in the Arctic, sub-Arctic, or other parts of the world. These events have been designed to specifically stress USCG, and more broadly, DHS capabilities and do not reflect a judgment of the likelihood of any event occurring in the Arctic. Additional details may be needed depending on the nature of the scenario-based discussion in which these events are used. This includes specifying weather conditions and time of year, the number of individuals at risk in a scenario, and the capabilities of other agencies or private-sector entities that may be involved in a given response. Narratives for each stressing event discussed at the workshops are presented below.

“Deepwater Horizon North”

Figure A.1. “Deepwater Horizon North” Context

SOURCE: Google Maps.

In September, an explosion occurs on an oil rig, about 50 nautical miles north of Prudhoe Bay in the Beaufort Sea. The rig is a joint venture between U.S. and Canadian energy companies. The cause is not immediately known but is believed to be related to complications sealing the well, as personnel on the rig reported concerns over pressure build-up just prior to the explosion. There are over 100 people on the rig, which is now on fire. During a recent inspection by U.S. officials, the rig operators were found to be noncompliant with required spill response capabilities. The company submitted a plan of action to get in compliance, but the current status of that progress is unknown. The explosion also triggers a massive release of oil into the ocean. The Beaufort Sea is home to many protected species, including polar bears, ringed seals, and six types of whales.

Response elements: Launch a mass rescue operation, provide medical care, put out the fire, assess and mitigate the oil spill, conduct environmental assessments on wildlife and habitats, identify impacts to cultural activities and indigenous subsistence, provide temporary shelter for survivors, and assist foreign personnel in returning to their home countries.

Key organizations: FEMA, USCG, U.S. Department of the Interior, Bureau of Safety and Environmental Enforcement, Environmental Protection Agency (EPA), State Department, Immigration and Customs Enforcement (ICE), Alaska Regional Response Team, and state and local authorities.

Derivation: This event draws from the Deepwater Horizon oil spill in the Gulf of Mexico.

"Smugglers' Paradise"

Figure A.2. "Smugglers' Paradise" Context

SOURCE: Google Maps with author overlay.

Transnational criminal organizations (TCOs) increasingly smuggle drugs and conduct human trafficking via the Arctic into North America. Elevated economic activity in the region and insufficient law enforcement presence enables TCOs to use cargo and fishing vessels for trafficking, but there are also indications that TCOs also use state-flagged ships (with and without the knowledge of the state) for trafficking. Drug smuggling rings are aided by local community groups seeking to improve economic conditions of the community. It has been challenging for law enforcement to make any headway on investigations as local community members have resisted cooperating with investigations. Nome and Deadhorse are two key areas for illegal trafficking. Nome serves as a regional hub for cargo shipping and seafood harvesters and processers. Deadhorse has a public airport and is accessible via the Dalton Highway from Fairbanks.

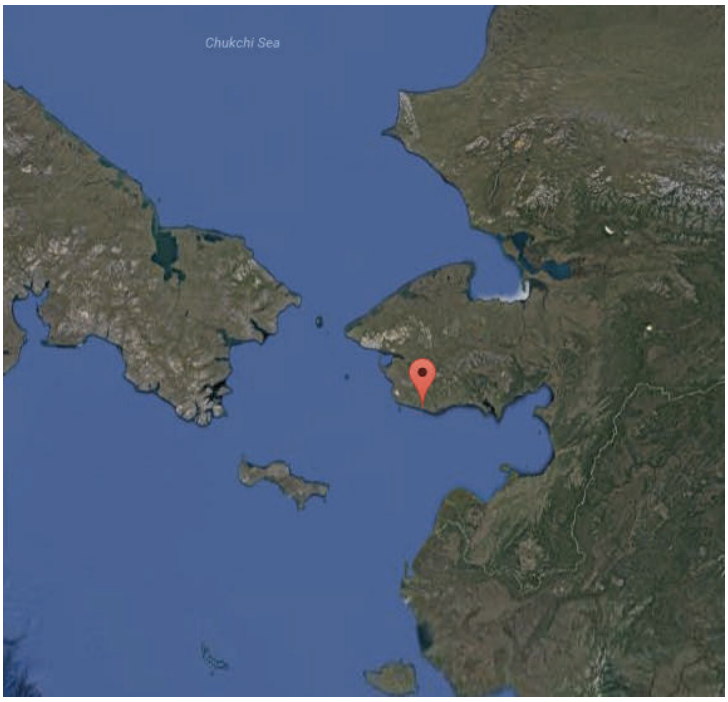
Response elements: Investigate suspected vessels and target transnational criminal organizations, possibly provide temporary shelter and immediate medical care for victims of human trafficking, possibly assist in returning foreign nationals to their home countries, work with other nations to stop the illicit trade, interdict and prosecute vessels engaged in illegal fishing, and conduct any other necessary law enforcement activities.

Key organizations: DHS Intelligence and Analysis, wider Intelligence Community, USCG, State Department, the Interdiction Committee, Drug Enforcement Administration, Office of National Drug Control Policy, Border Patrol, ICE, Citizen and Immigration Services, DHS Office for Civil Rights and Civil Liberties, Citizenship and Immigration Services Ombudsman, Office of Operations Coordination, Department of Justice, and state and local authorities.

Derivation: This event reflects some of the maritime smuggling currently taking place from the Middle East and Africa to Europe via the Mediterranean, as well as from Colombia and Ecuador up through Central America, Mexico, and the southern United States.

"Build It and They Will Come"

Figure A.3. "Build It and They Will Come" Context



SOURCE: Google Maps.

The establishment of a privately owned deepwater port at Nome encourages additional mining and other shipping activities. The port serves as a regional hub for seafood harvesters and processers and accommodates increased vessel activity in the Bering Strait, which has doubled over the past decade. The port also supports national security and life safety interests enabling responsible organizations to respond to increasing foreign presence and increasing economic activity in the Arctic, including tourism. The port is equipped with four loading berths, including two berths that can accommodate very large crude carriers and two berths that can accommodate fully laden Panamax ships. There is also a liquefied natural gas terminal at the port. The port

connects to a new and improved Alaska Railroad, which was recently extended from Fairbanks west to Nome. The port is thriving as a trans-shipment port because of the high costs of oil and proximity to a more accessible Arctic shipping route.

Local communities are generally supportive of the development, seeking opportunities to improve local economic and social conditions. Although disputes did arise during the permitting and design phases, community members played a pivotal role in ensuring that the port was developed responsibly and that operations minimize impacts to traditional lifestyles. Environmental activists have opposed the expansion of the port, claiming the increased activity will be detrimental to the environment, particularly the tanker traffic that is expected to increase as hydrocarbon exploration and extraction projects in the Arctic get under way.

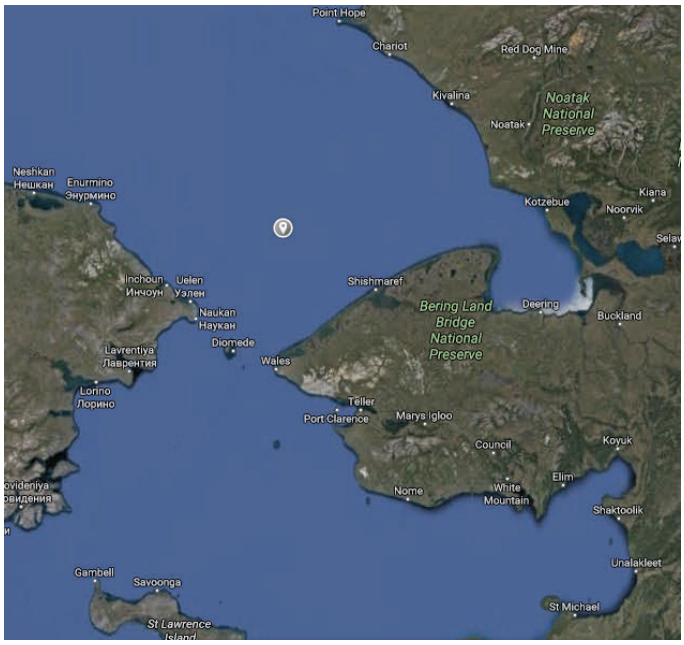
Response elements: Conduct law enforcement activities, interdict vessels engaged in illegal fishing, prepare to respond to a variety of potential environmental, security, and safety incidents.

Key organizations: TSA, Customs and Border Protection Office of Field Operations, EPA, ICE, USCG, DHS Office of Partnership and Engagement, National Protection and Programs Directorate, U.S. Fish and Wildlife Service, and state and local authorities.

Derivation: This event draws from the construction of Jebel Ali, United Arab Emirates, in the 1970s. Jebel Ali is now the ninth-busiest port in the world, handling cargo related to a resource-rich region near the entrance to a key waterway. To adapt this example for the Arctic, the event also draws from the Army Corps of Engineers study for an Arctic Deep Draft Port, the Nome Strategic Development Plan, and other existing deep draft ports in the Arctic.

"Bump"

Figure A.4. "Bump" Context



SOURCE: Google Maps.

A U.S. oil tanker headed south through the Bering Strait near Kotzebue Sound unexpectedly collides with a bulk carrier at the end of the ice-free season. At the time of collision, the bulk carrier's country of registry, origin, route, destination, and cargo are unknown. U.S. authorities suspect that the container ship may be carrying illicit cargo or operating in violation of an embargo, because it appears that the carrier's radar was deliberately turned off and its AIS was transmitting a false location. The U.S. tanker begins to leak crude oil into the Chukchi Sea; because of the direction of the ocean currents, the oil is expected to impact both U.S. and Russian territory if the spill is not contained within 24 to 48 hours. The bulk carrier is disabled. There are injuries on the U.S. oil tanker, but the health status of passengers and crew on the bulk carrier is unknown. Medical facilities in the nearby coastal Alaskan villages are limited to basic triage.

Response elements: Carry out rescue operations (in a potentially hostile environment in the case of the bulk carrier), contain the crude oil spill and mitigate its impacts, investigate the bulk carrier and why the accident occurred, and conduct any necessary law enforcement activities.

Key organizations: USCG, DHS Intelligence and Analysis, Domestic Nuclear Detection Office, EPA, State Department, ICE, Federal Bureau of Investigation, Intelligence Community, Alaska Regional Response Team, and U.S. Fish and Wildlife Service.

Derivation: This event draws from other events from around the world, including a USCG investigation of an oil tanker leak in September 2016 in California, Iranian oil tankers sending false signals to satellites to conceal voyages, the Malaysian ship *Selendang Ayu* losing power and running aground in the Aleutians in 2004, the Exxon *Valdez* incident of 1989, the collision of a Philippine passenger ferry (*St. Thomas Aquinas*) with a cargo ship in 2013, and the 1917 ship collision that caused a ship full of war-bound explosives to detonate and destroy much of Halifax, Canada.

"Cold Terror"

Figure A.5. "Cold Terror" Context

SOURCE: Google Maps with author overlay.

Local communities around Utqiagvik report hearing a series of explosions coming from an offshore cruise ship in the Chukchi Sea headed toward the Northwest Passage. It is late August. The ship issues a distress signal about 15 nautical miles from the coast, just west of Utqiagvik. The cruise ship is carrying approximately 1,000 passengers, but there is no information about casualties, whether the ship's captain and crew are alive, and whether the vessel is disabled. The vessel was in compliance with safety regulations at the last inspection, which was nine months ago, but this cruise liner has operated in the Arctic for only two weeks and typically trains for emergency situations in warmer waters.

There are active offshore drilling operations about 50 nautical miles from the shore northwest of the cruise ship, for which the status of operations is unclear. A terrorist organization claims responsibility, but the source of the explosions remains unclear. Local communities prepare to ensure safety and provide emergency shelter and medical care, but facilities are limited and

cannot accommodate all passengers and crew of the cruise liner. Local communities have small-scale fishing vessels, but there are no USCG vessels within 500 nautical miles at this time.

Response elements: Begin a mass rescue operation in coordination with local communities, provide medical and other support, get the cruise ship to land, and assess the possibility of a terrorist attack and whether there continues to be a threat onboard the ship.

Key organizations: USCG, DHS Intelligence and Analysis, FEMA, TSA, state of Alaska, native and local authorities, DHS Office of Partnership and Engagement, and DHS Office of Operations Coordination.

Derivation: This event draws from an amalgam of events that have happened in several other locations. These include the 1985 hijacking of the Italian cruise liner *Achille Lauro* by the Palestinian Liberty Front off the coast of Egypt, as a well as a terrorist attack in 2004 that resulted in the sinking of the Philippine *SuperFerry 14* and the deaths of 116 people. Other events include the seizure of offshore oil platforms and destruction of pipelines, both of which are recurring problems in the Niger Delta region. Explosive suicide boats were widely used by the Tamil Tigers in Sri Lanka for decades, as well as against the USS *Cole* in 2000 and a French vessel in 2002. Improvised floating maritime explosive devices have been used by insurgents since 1777; most recently, an unknown actor used one in Libya in 2011.

"Cyber Lights Out"

Figure A.6. "Cyber Lights Out" Context

SOURCE: Google Maps with author overlay.

Kotzebue, Nome, and Dillingham areas all lose electric power within a few hours of each other. It is the middle of winter. Each city has recently modernized and expanded its electrical grid infrastructure to enable increased use of renewable energy sources (primarily geothermal and wind) and remote power usage monitoring. Advances in technology have made upgrades like these cost-effective in rural parts of Alaska and diminished their heavy reliance on diesel fuel for power generation. The cause of the power loss is initially unknown, but a cyber attack is suspected because there is no immediate alternative explanation, such as a severe regional storm, (which would have likely knocked out power in neighboring communities as well). There has been an increase in recent months of reported cyber intrusions into the nation's electrical grid.

Grid operators struggle to get the grid back up and estimate that power could be down for several hours to days. Each community has some emergency backup power-generating capability through diesel generators, but fuel storage is low and they are not expecting a new delivery for another week.

Response elements: Determine the extent of the power outages and provide assistance to local communities until power can be restored; investigate the cause of the power outage.

Key organizations: FEMA, DHS Intelligence and Analysis, the wider Intelligence Community, the state of Alaska, native and local authorities, U.S. Department of Energy, National Protection

and Programs Directorate, DHS Office of Partnership and Engagement, and DHS Office of Operations Coordination.

Derivation: This event is loosely based on the cyber attack on the Ukrainian power grid. In December 2016, a coordinated cyber attack on three separate energy providers left more than 225,000 Ukrainian residents without power. Power was restored relatively quickly by operating in manual mode, but it took months for the operators to regain computerized control of their systems.

"Icy Standoff"

Figure A.7. "Icy Standoff" Context

SOURCE: Google Maps.

Over the past decade, the United States has expanded lease programs for offshore drilling in the Arctic and oil prices have steadily risen, renewing energy company interest in hydrocarbon exploration and drilling. Angry about new drilling occurring in the shallow waters of Smith Bay, about 90 miles east of Utqiagvik, a fringe group uses a fishing vessel to harass petroleum company personnel working on offshore drilling infrastructure. A number of members of the activist group are also surrounding the rig in kayaks, and it is suspected that all members are armed. Members of the fringe group manage to board some of the barges carrying equipment. Law enforcement is called in to assist.

Water temperatures are cold enough that a "man overboard" could only survive 30 minutes or less, depending on his or her fitness level and body fat content. The activists do not appear to have cold water survival suits.

Response elements: Respond to a possible violent incident and remove the fringe group from the location, care for any injured personnel, and assess the danger posed by the fringe group.

Key organizations: DHS Intelligence and Analysis, USCG, and National Protection and Programs Directorate.

Derivation: This event is based on environmental activism that has occurred in response to Arctic oil exploration. For example, Greenpeace members protesting oil exploration in the Arctic managed to attach themselves and attempt to scale the Prirazlomnaya drilling platform in 2013 in Russian waters. In 2015, "kayaktivist" protests occurred against the Shell Arctic oil drilling rig, the Polar Pioneer, departing Seattle for the Chukchi Sea.

"Over the Top"

A U.S.-based passenger airplane crashes on sea ice while en route through the Arctic from Minneapolis to Beijing. It is the middle of July, and while the location of the crash is ice-covered, the majority of the Arctic is ice-free or has navigable ice cover. Temperatures around the area of the crash range from 10 to 35 degrees Fahrenheit at this time of the year. The plane's last known location is north of the Alaska–Yukon Territory, Canada, Arctic border, just over the disputed waterways. Terrorism is suspected because of a distress signal received before the crash. Although it is unlikely, there may be some survivors. The plane was not equipped with any specialized cold weather gear but did have enough lightweight fleece blankets for all passengers.

It is unclear if the crash involved hazardous or toxic materials, so rescue operators need specialized Arctic hazardous material gear. Environmental impacts of the crash must also be addressed if there are toxic or hazardous materials identified.

Response elements: Work with the Canadian government to locate the aircraft, assess whether survivors are present, conduct a mass rescue operation, and identify the source of possible terrorist activity; deal with potential hazardous substances; and address environmental impacts.

Key organizations: TSA, USCG, FEMA, State Department, and Federal Aviation Administration.

Derivation: This event is loosely based on missing Malaysia Airlines Flight 370, which lost communications hundreds of miles southwest of Australia over very remote waters. As aircraft increasingly transit polar routes to gain cost efficiencies, risks of emergency landings or crashes in the Arctic increase.

"Small Boats, Big Problems"

Figure A.8. "Small Boats, Big Problems" Context

SOURCE: Google Maps.

A foreign adventure group decides to attempt the challenge of kayaking near Prudhoe Bay during the summer. Unfavorable sea conditions result in an early end to the expedition. Most of the group successfully makes contact with a local community, but two are missing. It is not clear whether the missing two are still at sea or perhaps lost down the shore from the location of the local community. Three of the kayakers in the community need medical attention beyond what the local community can provide.

Before ending the expedition early, the adventure group had divided up its survival equipment. It is unclear if the two missing kayakers have the necessary equipment with them to survive. The satellite phone held by the group is not with the two missing kayakers, and there are no other tracking devices.

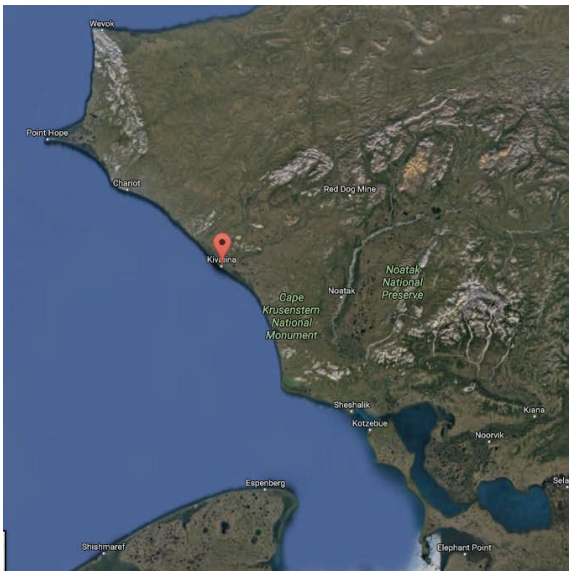
Response elements: Commence a SAR expedition, support the local community in providing shelter and medical care for the kayakers, medevac the three injured kayakers, and confirm the benign intentions of the adventure group.

Key organizations: USCG, DHS Intelligence and Analysis, and Customs and Border Patrol Office of Field Operations.

Derivation: This event draws from Jonathan Waterman's crossing of the Northwest Passage by kayak (described in the book *Arctic Crossing*), as well as the increase in interest in adventure tourism by kayak in the Arctic.

"Storm Front"

Figure A.9. "Storm Front" Context



SOURCE: Google Maps.

Late-summer storms batter Kivalina and other northwestern Alaska coastal communities. A major storm surge destroys homes, stores, and other infrastructure. Approximately five local community members are unaccounted for, including one child. The rest of the community is sheltering in a damaged school building or in tents. Kivalina has minimal medical triage capability. So far, only minor, non–life-threatening injuries have been reported, such as a broken arm and a few concussions. There is no electricity and there is limited access to clean water and food, although the community has a strong tradition of subsistence hunting. Additional storms are expected in the next few weeks.

Seasonal USCG assets, including a buoy tender and two helicopters at Kotzebue, were damaged in a storm surge the previous week, although one of the helicopters should be repaired within a few days.

Response elements: Launch a rescue operation, provide temporary shelter and medical care, relocate or rebuild local communities, and recover federal and state resources lost or damaged in the storm surge.

Key organizations: FEMA, USCG, National Protection and Programs Directorate, state of Alaska, native and local authorities, DHS Office of Partnership and Engagement, and DHS Office of Operations Coordination.

Derivation: This event is loosely based on Hurricane Katrina and its aftermath, taking into account increasing storm severity and coastal erosion in the Arctic over time.

"Fish Fight"

Foreign fishing vessels are increasingly aggressive in fishing in the U.S. sub-Arctic and Arctic high seas and EEZ, alternately claiming it as their traditional fishing grounds or a shared asset for all nations. Since the United States is still not a signatory to the United Nations Convention on the Law of the Sea, the United States may not be able to expect international support enforcing its EEZ claims. The foreign nation's coast guard and naval vessels enter the area, along with aircraft, conducting "freedom of navigation" operations and closely approaching U.S. fishing or even USCG vessels. In a couple of cases, large vessels from that nation even ram USCG cutters. Several foreign-flagged vessels are suspected of off-loading undeclared catch onto transport vessels at sea and delivering catch directly to foreign ports. Some U.S. and foreign-flagged vessels are also suspected of misdeclaring catch. It is estimated that there are approximately 15 foreign vessels for every one U.S. enforcement vessel.

Environmental activists call for stronger law enforcement to protect the Arctic fisheries and the U.S.-protected species often injured or killed as bycatch, such as seals or whales. Some of these protesters have arrived in the contested waters in kayaks, small vessels, and even a privately owned icebreaker. The presence of the protesters means that decisive action against the foreign nation's vessels may endanger the civilian protesters in the area.

Response elements: Investigate suspected vessels, conduct other law enforcement activities, respond to threats to U.S. sovereignty, and the protesters while trying to remove them from the area.

Key organizations: State Department, USCG, NOAA, DoD, DHS Intelligence and Analysis, and the wider Intelligence Community.

Derivation: This event draws from the current situation in the South China Sea, with fishing vessels backed by a state actor attempting to assert rights that are not justified in international law. This has included ramming other vessels, including those of other nations' coast guard. Misdeclaring catches and offloading undeclared catches to transport vessels occurs in several places around the world. For example, the World Wildlife Fund recently analyzed trade data for the Russian king crab fishery and found that U.S. and Japanese imports were twice the legal Russian total allowable catch from 2010 to 2012.

Fully Written Scenario Example: "Deepwater Horizon North" in an "Arctic Wild West"

In this example, we demonstrate how to put together the future factors and events to arrive at a long form scenario (this one was featured in Workshop I). This is intended to illustrate how the toolkit presented earlier in this appendix can be used to build scenario narratives. To make the narrative flow, we modified some of the future state narratives from their original form presented in the body of this report. Table A.5 summarizes the future factors for the "Arctic Wild West" future, which formed the building blocks for the narrative provided below.

Table A.5. Future Factor Summary for "Arctic Wild West" Future

Future Factor	Future State
Physical environment	Modest warming, impacts differ across the Arctic
Economic	"Boom" across the Arctic
Technology	Advances lead to all-weather drilling capabilities
Policy and regulatory environment	Environmental regulations loosened, legal immigration prioritized
Domestic safety and security	Local community instability, increasing criminal activity
Geopolitics and international security	Stable governance and cooperation punctuated with occasional tensions
Social	Mass migration into the Arctic to support industry
Infrastructure (fixed)	Private and government investment in infrastructure to support industry
Infrastructure (mobile)	No new assets are procured

Scenario Context

It is now 2030. The climate has warmed moderately, resulting in reduced duration of sea ice presence, delayed timing of land deep freeze, and increased duration and areas of permafrost thaw. These physical patterns result in changes to land and sea access in the Arctic. The Arctic Ocean is seasonally accessible for all practical purposes, although maritime access increases unevenly across the Arctic, affecting individual shipping routes differently. Both cargo ships and tankers are able to transit the Northern Sea Route and the Northwest Passage. The Bering Strait is open from late May to early December, with a ten-week shoulder season (five weeks on either side). The Northwest Passage is essentially ice-free for five weeks, with a six-week shoulder season (three weeks on either side). The Northern Sea Route is essentially ice-free for nine weeks, with a ten-week shoulder season (five weeks on either side), and the transpolar route is open for six weeks, with a ten-week shoulder season (five weeks on either side).

On land, there is increasing coastal erosion, shorter duration of ice road availability, loss of soil support, fluctuations in land surface height, increased flooding, and increased risk of liquefaction during earthquakes. These environmental conditions, along with increased storm

intensity and rising seas, pose challenges for building long-term resilient infrastructure, but favorable economic conditions provide motivation for infrastructure investment by industry.

Advances in vessel design and operation lead to ice-capable or all-weather drilling capabilities. This technology allows for a boom in hydrocarbon extraction in the Arctic. The combination of increased maritime access, rapid technological advancement, and increasing demand for Arctic resources, including fish, hydrocarbons, and minerals, greatly increase the extent of economic activity in the Arctic. Additionally, some Arctic nations relax environmental regulations; for others, regulations have not kept pace with technological advances. In both cases, markets barriers to entry are lowered, which dramatically increases the number of industry players. This poses challenges for maritime law and safety enforcement. Environmental activists ramp up activities, and the region faces high levels of media attention as a result of the rapid development and conflicts with environmentalists.

Commercial shipping increases substantially to accommodate both resource extraction and population growth that has occurred with increased economic activity. Moreover, trans-Arctic shipping grows exponentially, reflecting the fuel savings associated with shorter routes and political or military crises that jeopardize or close key routes elsewhere. Shipping standards and routes are still being developed. The International Maritime Organization continues to revise and refine the Polar Code as the environment changes and technology advances, but it is criticized by environmental nongovernmental organizations for not having strict enough requirements.

Tourism grows exponentially, but international adherence to safety standards by companies in non-Arctic nations is spotty. International coordination and agreements for navigational safety, pollution response, and SAR move forward smoothly, but there are some questions as to whether all of the nations involved have the capabilities required by the agreements. Increases in individual adventurers and kayaktivists protesting oil extraction in the Arctic pose challenges for SAR as economic activity increases. Known requirements for investment in icebreakers, ships, helicopters, and fixed-wing aircraft continue to be difficult to fund in a constrained budget environment. Federal law enforcement must rely on existing local assets, and international SAR requirements are not met.

The area's population sharply rises, with extremely large seasonal peaks, as people migrate to the region to support new industry activity. Immigration regulations are generally more restrictive, but the number of illegal immigrants in the United States has not changed. Legal immigration is prioritized through guest worker programs. People come to work in the United States legally—specifically in booming industries in the Arctic—but more people overstay their visas, which poses challenges for immigration enforcement. Local communities protest the guest worker programs because they feel immigrants are taking their jobs. Local communities also protest environmental damages caused by increased development in the area.

Complicating matters, as security at the southern border of the United States increases, the relatively unpopulated and undermonitored Arctic border becomes a new route for drug smuggling, human trafficking, illegal migration, and criminal activity. Transnational criminal

organizations leverage elevated levels of economic activity in the Arctic to conduct criminal activity. Partnerships between indigenous groups and local law enforcement are weak, preventing effective law enforcement in areas where government resourcing is low. Drug and sex trafficking are both on the rise in the Arctic as population and economic activity in Alaska increases. While local law enforcement is challenged in some areas, the Arctic is positioned to become an arena for effective international anticrime partnerships and coordination, with Arctic anticrime task forces coordinating to monitor and deter large-scale criminal organizations.

Infrastructure is built rapidly to accommodate changes in industry and population but not with longevity in mind. Fortunately, long-term planning efforts are under way by government and private entities. Under the Arctic Council, the transportation infrastructure working group successfully develops a comprehensive transportation infrastructure plan. Several Arctic nations have already implemented parts of the plan, although it is not expected to be complete until the late 2030s. Increased economic development leads private companies to also develop long-term infrastructure plans for making access to the Arctic easier, safer, and less expensive. In 2029, the United States completed construction on the last leg of an 800-mile natural gas pipeline from the North Slope of Alaska to Nikiski, where the gas is chilled into liquefied natural gas and shipped on tankers. Additionally, a new road that runs from Utqiagvik through the National Petroleum Reserve to Nuiqsut has been built, although road maintenance continues to be challenging in thawing permafrost zones. Basic sewer and water infrastructure has been built in some rural Arctic Alaska areas in preparation for the relocation of native villages with severe coastal erosion.

Internationally, Arctic governance is stable and cooperation among nations is resilient. Occasional tensions arise over waterways and continental shelf claims but are resolved peacefully to maintain a positive environment for economic growth. Concerns within U.S. leadership and among U.S. allies over the Russian military buildup from a decade ago have subsided, as Russia has continued to be an active, cooperative participant in Arctic matters. Other nations that previously announced intentions to increase defense spending and increase troop levels in the Arctic in response to Russian military activity have withdrawn from those efforts. However, both Russia and the United States maintain a military presence, consistent with 2017 levels, in the Arctic.

The Commission on the Limits of the Continental Shelf recently provided recommendations that settle the Russian, Danish, and Canadian submissions to extend their respective continental shelves. The commission recommendations indicate that the scientific evidence provided by all three submissions validate each claim, including areas of overlap of the Lomonosov Ridge and the Alpha-Mendeleev Ridge. With these recommendations, the three countries begin formal negotiations to delimitate their respective continental shelves. The United States still has not acceded to the convention.

Event: Deepwater Horizon North

SOURCE: Google Maps.

In September, an explosion occurs on an oil rig, about 50 nautical miles north of Prudhoe Bay in the Beaufort Sea. The rig is a joint venture between U.S. and Canadian energy companies. The cause is not immediately known but is believed to be related to complications sealing the well, as personnel on the rig reported concerns over pressure build-up just prior to the explosion. There are over 100 people on the rig, which is now on fire. During a recent inspection by U.S. officials, the rig operators were found to be noncompliant with required spill response capabilities. The company submitted a plan of action to get in compliance, but the current status of their progress is unknown. The explosion also triggers a massive release of oil into the ocean. The Beaufort Sea is home to many protected species, including polar bears, ringed seals, and six types of whales.

Response elements: Launch a mass rescue operation, provide medical care, put out the fire, assess and mitigate the oil spill, conduct environmental assessments on wildlife and habitats, identify impacts to cultural activities and indigenous subsistence, provide temporary shelter for survivors, and assist foreign personnel in returning to their home countries.

Key organizations: FEMA, USCG, U.S. Department of the Interior, Bureau of Safety and Environmental Enforcement, Environmental Protection Agency, State Department, ICE, Alaska Regional Response Team, and state and local authorities.

Derivation: This event draws from the Deepwater Horizon oil spill in the Gulf of Mexico.

Appendix B. Mapping Enablers to USCG Activities

In this appendix, we present a mapping of the enablers that were described in the context of Workshop I to specific activities that the USCG performs as part of its missions. To capture the activities associated with these missions, we use a series of structured logic models that describe elements of the USCG's 11 statutory missions.

In a prior study, RAND teams developed logic models that characterized the relationships among USCG activities, accomplishments, and outcomes for each of the USCG's 11 statutory missions.[3] The methodology used to develop the logic models is described in prior RAND publications, but will be described briefly here. Developing logic models entails characterizing the resource inputs that the organization has to work with, the activities that the organization conducts with these inputs, the direct results (termed outputs or accomplishments) of these activities, the higher-level outcomes that these are intended to achieve, and sometimes the strategic goals (or strategic outcomes) to which that organization and others contribute. It typically involves analysis of documentary sources and expert interviews, as well as an iterative process in which the logic model is revised based on further inputs. Note that other logic models exist, including those developed by the USCG.[4]

The logic models that characterize the USCG's missions, and that are discussed throughout this appendix, were developed based on extensive review of USCG documents and copious interviews with subject-matter experts. They were subsequently reviewed by USCG experts, who provided helpful feedback that increased the models' fidelity. While these logic models have not been formally adopted by the USCG, they provide a reasonable representation of the USCG's 11 statutory missions for analytical purposes.

In this appendix, we present mappings of the activities enumerated in the logic models to the various enablers that were discussed in the Arctic workshops. We analyzed whether a particular enabler could play a key role in facilitating the activity in question in the Arctic. We recognize that the degree to which different activities are conducted in the Arctic will vary based on demand for the missions; activities associated with the living marine resources (domestic fisheries) mission may be more extensive than those associated with migrant interdiction, for example. However, to the degree that either mission is conducted, the activities that are a part of that mission benefit from the enablers that we document below.

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[3] Scott Savitz, Henry H. Willis, Aaron Davenport, Martina Melliand, William Sasser, Elizabeth Tencza, and Dulani Woods, *Enhancing U.S. USCG Metrics*, Santa Monica, Calif.: RAND Corporation, RR-1173-USCG, 2015.

[4] See, for example, U.S. Coast Guard, Assistant Commandant for Prevention, *Coast Guard Prevention Performance Measurement Framework: The Development of Metrics to Enhance Mission Performance and Improve Decision-Making*, December 30, 2007; U.S. Coast Guard, *Unified Performance Logic Model (UPLM): Enterprise Level of Detail*, May 28, 2009.

We present these mappings of activities to enablers below, grouping them under the broad USCG headings of safety, security, and stewardship.

Safety Missions

The SAR mission is focused on saving lives and property that are in danger at sea, while the marine safety mission primarily focuses on regulatory oversight to prevent accidents that can cause fatalities, injuries, pollution, or property damage. The logic models for these two missions are shown in Figure B.1, together with a mapping of the enablers to specific activities within the logic models. Clearly, policies, plans, partnerships, and domain awareness enable both missions. In addition, many of the enablers contribute to the posturing and deployment of assets to enable fulfillment of the SAR mission.

Figure B.1. Mapping of Safety Activities to Key Enablers

Search and Rescue	Plans and Partnerships		Infrastructure						Response Capabilities		Information	Vehicles				
Activities	Policies and plans for Arctic operations and emergent situations	Local, state, federal, international, and public-private partnerships	Communications infrastructure	Logistical infrastructure	Coastal infrastructure	Navigational safety infrastructure	Forward operating locations	Medical trauma care facilities	Specialized environmental response capabilities	Deployable operations teams	Domain awareness technology	Icebreakers	Non-icebreaking, cold-weather-equipped vessels	Fixed-wing aircraft	Rotary-wing aircraft	Unmanned aerial vehicles
1.1.1. Place and employ communications infrastructure to monitor maritime environment			X		X						X					
1.1.2. Educate maritime community on available resources and how to employ them	X	X														
1.1.3. Notify Search and Rescue Unit (SRU) in a timely manner			X								X					
1.2.1. Posture assets (e.g., helicopters, boats, cutters) to respond effectively and rapidly				X	X		X			X		X	X	X	X	X
1.2.2. Ensure that responding crews are able to coordinate with other responding units and agencies when on-scene	X	X	X				X									
1.3.1. Develop search action plan and conduct operational risk evaluation, based on available information and appropriate software	X										X					
1.3.2. Deploy the appropriate Search and Rescue Unit (SRU) to execute the response				X	X		X			X	X	X	X	X	X	X
1.4.1. Develop SAR memoranda of understanding with strategic partners	X	X														
1.4.2. Foster bilateral, regional, interagency, international, private-sector, and other external SAR engagement		X														
1.4.3. Assist in the development of SAR policy, requirements, programs, and plans	X	X														
1.4.4. Establish domestic and international partnerships in order to save lives in the most effective manner		X														
1.4.5. Coordinate Automatic Maritime Vessel Emergency Response (AMVER)	X	X	X								X					
1.4.6. Respond effectively to surface picture (SURPIC) requests			X								X					

Marine Safety	Plans and Partnerships		Infrastructure						Response Capabilities		Information	Vehicles				
Activities	Policies and plans for Arctic operations and emergent situations	Local, state, federal, international, and public-private partnerships	Communications infrastructure	Logistical infrastructure	Coastal infrastructure	Navigational safety infrastructure	Forward operating locations	Medical trauma care facilities	Specialized environmental response capabilities	Deployable operations teams	Domain awareness technology	Icebreakers	Non-icebreaking, cold-weather-equipped vessels	Fixed-wing aircraft	Rotary-wing aircraft	Unmanned aerial vehicles
1.1.1. Monitor, inspect, examine, and investigate facilities, vessels, and contents (such as containers, bulk goods, and ballast water)											X					
1.1.2. Cite non-incident related safety worklist items from facility/vessel inspections and note accordingly into MISLE casework narrative	X															
1.2.1. Provide consultation to industry advisory bodies and conduct maritime sector outreach	X	X														
1.2.2. Administer licensing and credentialing program for professional mariners and vessel documentation/decal programs	X															
1.2.3. Provide regulatory, safety, and compliance guidance, as well as information regarding best practices, to all stakeholders	X	X														
1.2.4. Monitor and report North Atlantic iceberg conditions using fixed-wing aircraft and reports from ships as part of the International Ice Patrol			X								X			X		X
2.1.1. Document incident and collect evidence	X															
2.1.2. Determine incident causal factors											X					
2.1.3. Identify responsible parties											X					
2.1.4. Assist interagency, state, and local investigations		X														
2.1.5. Disseminate investigation findings for use in improved regulation to field and industry			X													
2.2.1. Issue appropriate citations	X															
2.2.2. Prepare case package for prosecution																

Security Missions

To reiterate, there are four missions grouped under the rubric of security, as follows:

- ports, waterways, and coastal security (preventing maritime attacks)
- drug interdiction
- migrant interdiction
- defense readiness (supporting DoD).

These are mapped to the enablers in Figures B.2 (ports, waterways, and coastal security and drug interdiction) and B.3 (migrant interdiction and defense readiness). Several patterns are apparent. Looking at these matrices from a vertical perspective, it is clear that policies, plans, and partnerships enable a range of activities, as was the case for the safety missions. Forward locations, deployable teams, domain-awareness technology, and vehicles are also enablers for multiple activities. Looking from a horizontal perspective, it is also clear that most of the enablers contribute to exercises, joint operations, patrols, surges, and incident management.

Figure B.2. Mapping of the PWCS and Drug Interdiction Missions to Key Enablers

Ports, Waterways, and Coastal Security			Plans and Partnerships		Infrastructure						Response Capabilities		Information	Vehicles				
Outcomes	Accomplishments	Activities	Policies and plans for Arctic operations and emergent situations	Local, state, federal, international, and public-private partnerships	Communications infrastructure	Logistical infrastructure	Coastal infrastructure	Navigational safety infrastructure	Forward operating locations	Medical trauma care facilities	Specialized environmental response capabilities	Deployable operations teams	Domain awareness technology	Icebreakers	Non-icebreaking, cold-weather-equipped vessels	Fixed-wing aircraft	Rotary-wing aircraft	Unmanned aerial vehicles
1. Enhance preparedness for and prevention of maritime terrorist attacks	1.1. Ensure vessel and facility compliance with maritime security laws and regulations	1.1.1. Ensure plans are in place and review to ensure adequacy	X															
		1.1.2. Conduct inspections and boardings to ensure plans are followed	X				X											
		1.1.3. Enforce transportation worker identification credentialing (TWIC)	X	X	X													
		1.1.4. Conduct external patrols to assess security measures			X				X			X	X	X	X	X	X	X
	1.2. Collect intelligence in collaboration with other agencies and entities	1.2.1. Collect intelligence											X					
		1.2.2. Contribute to collaborative bodies and organizations to analyze, integrate, and disseminate intelligence		X														
		1.2.3. Share relevant intelligence information with other stakeholders as appropriate	X	X	X													
	1.3. Ensure PWCS preparedness	1.3.1. Conduct Coast Guard exercises	X		X	X	X		X	X	X	X	X	X	X	X	X	X
		1.3.2. Conduct exercises with external entities	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		1.3.3. Conduct outreach with the public		X														
		1.3.4. Engage with the other members of the Area Maritime Security Committee		X														
2. Deter potential maritime terrorist attacks; counter and respond to actual maritime terrorist attacks	2.1 Maintain presence near critical or vulnerable targets	2.1.1. Conduct waterborne, air, or shoreside patrols around high-risk infrastructure or events			X		X	X	X			X	X	X	X	X	X	X
		2.1.2. Escort vessels					X	X						X	X			
		2.1.3. Conduct random and targeted security boardings of vessels			X				X			X	X		X			
		2.1.4. Enforce fixed security zones	X	X	X				X			X	X		X			X
	2.2. Counter terrorist attacks when cued by intelligence or events	2.2.1. Surge to respond to security threats when alerted	X	X	X	X	X	X	X			X	X	X	X	X	X	X
		2.2.2. Provide Transit Protection Support (TPS)	X						X			X	X		X			

Drug Interdiction			Plans and Partnerships		Infrastructure						Response Capabilities		Information	Vehicles				
Outcomes	Accomplishments	Activities	Policies and plans for Arctic operations and emergent situations	Local, state, federal, international, and public-private partnerships	Communications infrastructure	Logistical infrastructure	Coastal infrastructure	Navigational safety infrastructure	Forward operating locations	Medical trauma care facilities	Specialized environmental response capabilities	Deployable operations teams	Domain awareness technology	Icebreakers	Non-icebreaking, cold-weather-equipped vessels	Fixed-wing aircraft	Rotary-wing aircraft	Unmanned aerial vehicles
1. Reduce the maritime flow of illegal drugs	1.1. Deter, divert, detain, and disrupt maritime drug-smuggling flows	1.1.1. Detect and monitor											X	X	X	X	X	X
		1.1.2. Intercept											X	X	X		X	
		1.1.3. Interdict										X	X	X	X		X	
		1.1.4. Board and apprehend						X				X	X	X	X		X	
		1.1.5. Achieve visible or perceived presence				X	X		X			X		X	X	X	X	X
	1.2. Support and coordinate with other agencies and international partners to counter maritime drug flows (achieving unity of effort)	1.2.1. Conduct joint operations (including shiprider operations) and exercises with other agencies and nations	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		1.2.2. Assist partner nations in the development of capabilities to counter drug flows		X														
		1.2.3. Develop memoranda of understanding and agreement with other agencies and nations to enable more effective counter-drug operations		X														
	1.3. Enable prosecution of smugglers	1.3.1. Collect and handle evidence for prosecution purposes																
		1.3.2 Document case details and prepare case packages for prosecution	X															
2. Increase intelligence and situational awareness of maritime drug flow	2.1. Conduct intelligence, surveillance, and reconnaissance (ISR) activities to counter drug flows and trafficking networks	2.1.1. Investigate vessel and other physical evidence																
		2.1.2. Interview apprehendees																
		2.1.3. Deploy ISR systems							X				X	X	X	X	X	X
		2.1.4. Collect and integrate ISR systems' data			X								X					
		2.2.1. Engage in interagency bodies and liaise with other agencies to create actionable intelligence, enable information sharing, and foster intelligence collaboration		X	X								X					

Figure B.3. Mapping of the Migrant Interdiction and Defense Readiness Missions to Key Enablers

Migrant Interdiction			Plans and Partnerships		Infrastructure						Response Capabilities		Information	Vehicles				
Outcomes	**Accomplishments**	**Activities**	Policies and plans for Arctic operations and emergent situations	Local, state, federal, international, and public-private partnerships	Communications infrastructure	Logistical infrastructure	Coastal infrastructure	Navigational safety infrastructure	Forward operating locations	Medical trauma care facilities	Specialized environmental response capabilities	Deployable operations teams	Domain awareness technology	Icebreakers	Non-icebreaking, cold-weather-equipped vessels	Fixed-wing aircraft	Rotary-wing aircraft	Unmanned aerial vehicles
1. Deter undocumented maritime migration attempts	1.1. Raise public awareness regarding policies concerning, countermeasures against, and consequences of undocumented migration	1.1.1. Implement public-affairs campaigns in source countries in coordination with other agencies		X														
		1.1.2. Implement public-affairs campaigns domestically in coordination with other agencies		X														
		1.1.3. Publicize successful prosecutions and associated prison sentences for smugglers																
	1.2. Demonstrate effective presence and capability to deter maritime migration	1.2.1. Ensure high visibility throughout high-traffic vectors							X					X	X	X	X	X
		1.2.2. Ensure periodic visibility in low-traffic vectors				X	X		X					X	X	X	X	X
		1.2.3. Conduct high-profile mass-migration exercises	X	X	X	X	X	X	X			X		X	X	X	X	X
	1.3. Enable prosecution of smugglers	1.3.1. Identify, apprehend, and transfer smugglers		X	X	X	X		X			X	X	X	X	X	X	X
		1.3.2. Prepare case packages for prosecution of smugglers																
2. Prevent undocumented migrants from reaching U.S. territory via maritime routes	2.1. Build interagency and international partnerships to share information, coordinate plans, and operate cohesively	2.1.1. Engage in interagency bodies, leverage interagency centers, exercise with other agencies, and operate alongside other agencies	X	X	X				X				X		X	X	X	X
		2.1.2. Engage bilaterally and multilaterally to enable information sharing, shipriding, training, enhancement of partner-nation capabilities, and cooperative efforts		X	X													
		2.1.3. Continue development of bilateral agreements to facilitate the swift repatriation of migrants after interdiction		X														
	2.2. Achieve enhanced situational awareness and knowledge regarding undocumented migration	2.2.1. Enhance abilities to predict emerging migration threats and new smuggling routes											X					
		2.2.2. Estimate migrant flow											X					
	2.3. Detect, interdict, and repatriate migrants (or enable repatriation)	2.3.1. Detect migrants											X			X	X	X
		2.3.2. Interdict migrants	X	X	X										X			
		2.3.3. Repatriate migrants	X	X	X													
		2.3.4. Rescue migrants from overloaded and/or unseaworthy vessels			X	X	X	X	X	X		X	X		X		X	
		2.3.5. Provide humanitarian aid to interdicted migrants			X	X	X		X	X		X			X		X	
		2.3.6. Provide access to protection screening in accordance with law, policy, and agreements	X	X			X		X	X					X		X	

Defense Readiness			Plans and Partnerships		Infrastructure						Response Capabilities		Information	Vehicles				
Outcomes	**Accomplishments**	**Activities**	Policies and plans for Arctic operations and emergent situations	Local, state, federal, international, and public-private partnerships	Communications infrastructure	Logistical infrastructure	Coastal infrastructure	Navigational safety infrastructure	Forward operating locations	Medical trauma care facilities	Specialized environmental response capabilities	Deployable operations teams	Domain awareness technology	Icebreakers	Non-icebreaking, cold-weather-equipped vessels	Fixed-wing aircraft	Rotary-wing aircraft	Unmanned aerial vehicles
1. Fulfill DOD requirements	1.1. Provide teams and support for counter-terrorism, counter-drug, and coastal/port/harbor security operations	1.1.1. Provide Visit, Board, Search, and Seizure (VBSS) team support				X	X	X	X			X						
		1.1.2. Provide Redeployment Assistance and Inspection Detachment (RAID) support										X						
		1.1.3. Provide deployable force packages (e.g., K9, RWAI, MSRT, MSST)										X					X	
		1.1.4 Provide Airborne Use of Force (AUF) Capability Support															X	
		1.1.5. Provide Port Security Unit (PSU) Support					X		X			X						
	1.2. Conduct operations for combatant commanders	1.2.1. Conduct Theater Security Cooperation (TSC)		X		X												
		1.2.2. Conduct coastal air/surface operations			X	X	X	X	X				X	X	X	X	X	X
		1.2.3. Conduct port/harbor operations			X	X		X					X		X			
		1.2.4. Conduct Arctic/Antarctic coastal sea control operations			X	X			X				X	X	X	X	X	X
2. Maintain ability to respond to calls for forces	2.1. Maintain readiness of forces	2.1.1 Conduct independent/joint military training																
		2.1.2 Conduct independent/joint military exercises			X								X		X			
	2.2. Maintain interoperability with DOD forces	2.2.1. Conduct joint military operations			X	X							X		X			
		2.2.2. Conduct joint military communications			X													
3. Fulfill homeland defense requirements	3.1. Conduct interception and interdiction operations	3.1.1. Execute Rotary Wing Air Intercept (RWAI) duties															X	
		3.1.2. Provide cutters and boats for interception and/or interdiction operations				X								X	X	X	X	X
		3.1.3. Provide Law Enforcement Detachment Team (LEDET) support				X						X						
		3.1.4. Provide Maritime Operational Threat Response (MOTR) support			X	X						X						
	3.2. Conduct military environmental response operations	3.2.1. Conduct spill/release notifications			X							X	X					
		3.2.2. Conduct spill/release incident management		X	X	X	X	X	X	X	X		X		X	X	X	X
		3.2.3. Conduct spill/release containment/cleanup operations		X	X		X				X		X		X	X	X	X
		3.2.4. Conduct pollution incident investigation/documentation		X							X		X					

Stewardship Missions

As mentioned earlier, there are five stewardship missions:

- aids to navigation and waterway management
- ice operations (both icebreaking and monitoring of ice conditions)
- marine environmental protection (response to environmental spills)
- living marine resources (overseeing domestic fisheries)
- other law enforcement (countering illegal international fishing).

The logic models for these missions are mapped to the enablers in Figure B.4 (ice operations and aids to navigation and waterway management), Figure B.5 (marine environmental protection and living marine resources), and Figure B.6 (other law enforcement). Not surprisingly, icebreakers are a key enabler for multiple activities under ice operations, while navigational-safety infrastructure enables almost all of the aids to navigation activities. In addition, partnerships enable many of the activities under aids to navigation and marine environmental protection. Almost all of the enablers can contribute to deployment of responders under marine environmental protection. For the living marine resources and other law enforcement missions, many of the enablers contribute to achieving presence that can increase awareness and deter violations or enable action to be taken against them.

Figure B.4. Mapping of the Ice Operations and Aids to Navigation Missions to Enablers

Ice Operations			Plans and Partnerships		Infrastructure						Response Capabilities		Information	Vehicles				
Outcomes	Accomplishments	Activities	Policies and plans for Arctic operations and emergent situations	Local, state, federal, international, and public-private partnerships	Communications infrastructure	Logistical infrastructure	Coastal infrastructure	Navigational safety infrastructure	Forward operating locations	Medical trauma care facilities	Specialized environmental response capabilities	Deployable operations teams	Domain awareness technology	Icebreakers	Non-icebreaking, cold-weather-equipped vessels	Fixed-wing aircraft	Rotary-wing aircraft	Unmanned aerial vehicles
1. Facilitate safe and efficient activity in icy waters while reducing the risk and severity of ice-related incidents	1.1. Enable maritime commerce to proceed safely without significant delay despite icy conditions	1.1.1. Monitor and report ice conditions on coastal and inland waterways			X		X						X			X	X	X
		1.1.2. Ensure that vessels operating independently in ice have sufficient horsepower and hull reinforcement	X															
		1.1.3. Break ice to allow certain commercial vessels to utilize iced waterways as necessary												X				
		1.1.4. Coordinate with other public and private icebreaking entities to ensure adherence and appropriate modifications to standards		X										X				
	1.2. Enable access to ice-bound polar regions	1.2.1. Deploy polar-class icebreakers to polar regions				X			X					X				
	1.3 Minimize human casualties, property damage, and environmental damage from vessels beset in ice	1.3.1 Rescue vessels beset in ice		X					X	X				X				
	1.4. Minimize human casualties and property damage from flooding due to ice jams	1.4.1. Break ice jams that pose a flooding hazard												X				

Aids to Navigation and Waterways Management			Plans and Partnerships		Infrastructure						Response Capabilities		Information	Vehicles				
Outcomes	Accomplishments	Activities	Policies and plans for Arctic operations and emergent situations	Local, state, federal, international, and public-private partnerships	Communications infrastructure	Logistical infrastructure	Coastal infrastructure	Navigational safety infrastructure	Forward operating locations	Medical trauma care facilities	Specialized environmental response capabilities	Deployable operations teams	Domain awareness technology	Icebreakers	Non-icebreaking, cold-weather-equipped vessels	Fixed-wing aircraft	Rotary-wing aircraft	Unmanned aerial vehicles
1. Facilitate safe and efficient use of the marine transportation system	1.1. Reduce impediments to navigation	1.1.1. Regulate the placement and operation of bridges and offshore infrastructure over and in navigable waterways to minimize barriers to navigation		X				X										
		1.1.2. Coordinate with US Army Corps of Engineers and other entities to provide input on the regulation and removal of temporary and permanent potential obstructions to navigation		X				X										
		1.1.3. Maintain up-to-date Waterway Analysis and Management System (WAMS) for planning		X				X										
	1.2. Achieve high levels of mariner awareness of navigational conditions and environment	1.2.1. Regulate and plan the optimal placement and maintenance of public and private navigation infrastructure		X				X										
		1.2.2. Place, maintain, and (as necessary) remove navigational infrastructure						X										
		1.2.3. Provide maritime public with information regarding discrepancies in navigation infrastructure and other unpublished changes to maritime navigation safety			X			X										
	1.3. Reduce frequency of maritime accidents resulting from special circumstances	1.3.1. Establish, maintain, and monitor limited-access areas			X			X							X			
		1.3.2. Regulate maritime events	X	X	X		X	X		X			X				X	X
		1.3.3. Direct maritime traffic	X	X	X								X					

Figure B.5. Mapping of the Marine Environmental Protection and Living Marine Resources Missions to Enablers

Marine Environmental Protection			Plans and Partnerships		Infrastructure						Response Capabilities		Information	Vehicles				
Outcomes	**Accomplishments**	**Activities**	Policies and plans for Arctic operations and emergent situations	Local, state, federal, international, and public-private partnerships	Communications infrastructure	Logistical infrastructure	Coastal infrastructure	Navigational safety infrastructure	Forward operating locations	Medical trauma care facilities	Specialized environmental response capabilities	Deployable operations teams	Domain awareness technology	Icebreakers	Non-icebreaking, cold-weather-equipped vessels	Fixed-wing aircraft	Rotary-wing aircraft	Unmanned aerial vehicles
1. Decrease probability and prospective impact of spills/releases	1.1. Increase proficiency of responders and coordination with them	1.1.1. Conduct unit/responder, industry training, and awareness/maritime community outreach		X	X													
		1.1.2. Conduct interagency, state, local, and private-sector spill and disaster preparedness exercises, including government-initiated unannounced exercises (GIUEs)		X	X													
	1.2. Improve response plans	1.2.1. Assist with development of industry, state, and local response plans	X	X														
	1.3. Reduce risk from vessels and facilities	1.3.1. Conduct safety and MARPOL examinations of vessels and facilities					X											
2. Mitigate effects of spills/releases through response operations	2.1. As federal on-scene coordinator, ensure that spills and releases are contained and remediated	2.1.1. Monitor and document cleanup and remediation operations, supervise contractors, and coordinate among agencies		X	X						X							
		2.1.2. Deploy pollution first responders and respond to incident	X		X	X	X	X	X		X	X	X		X	X	X	X
	2.2. Conduct legal investigation of spill/release incident	2.2.1. Investigate incident by documenting evidence, pollution sources, causal factors, and responsible parties, while also contributing to others' investigations		X									X					
		2.2.2. Prepare for legal proceedings by issuing appropriate citations and prepare case packages for prosecution																
3. Monitor and communicate hazards to the public	3.1. Monitor and model flow of hazardous substances	3.1.1. Detect and track movements of hazardous substances			X								X			X	X	X
		3.1.2. Model the anticipated movements of hazardous substances											X					
	3.2. Inform the public to reduce exposure to hazardous substances	3.2.1. Designate evacuation and exclusion areas, based on current and anticipated hazards	X															
		3.2.2. Disseminate information regarding evacuation and exclusion areas	X		X													

Living Marine Resources			Plans and Partnerships		Infrastructure						Response Capabilities		Information	Vehicles				
Outcomes	**Accomplishments**	**Activities**	Policies and plans for Arctic operations and emergent situations	Local, state, federal, international, and public-private partnerships	Communications infrastructure	Logistical infrastructure	Coastal infrastructure	Navigational safety infrastructure	Forward operating locations	Medical trauma care facilities	Specialized environmental response capabilities	Deployable operations teams	Domain awareness technology	Icebreakers	Non-icebreaking, cold-weather-equipped vessels	Fixed-wing aircraft	Rotary-wing aircraft	Unmanned aerial vehicles
1. Prevent illegal fishing activities and other threats to marine species	1.1. Communicate and work with both other agencies and the general public	1.1.1. Continue and expand partnerships with other agencies		X														
		1.1.2. Conduct information-sharing and dissemination with the public		X														
	1.2. Enforce regulations	1.2.1. Maintain effective presence to achieve awareness and deter prospective violations				X	X		X				X	X	X	X	X	
		1.2.2. Monitor for and detect overt LMR violations (e.g., based on location, timing, activity, gear)											X					X
		1.2.3. Detect and deter less visible LMR violations by conducting random and/or targeted boardings											X		X	X	X	X
		1.2.4. Respond to LMR violations--document, disrupt, intercept, interdict, board/apprehend, process as appropriate	X										X		X			
		1.2.5. Cite violators and prepare cases for prosecution as appropriate		X														
	1.3. Contribute to conservation efforts	1.3.1. Monitor, collect, analyze, and disseminate information regarding specific marine species											X					
	1.4. Ensure Coast Guard compliance with laws and regulations for living marine resources	1.4.1. Engage with relevant Coast Guard units and programs to ensure knowledge of and adherence to laws and regulations	X	X														

Figure B.6. Mapping of the Other Law Enforcement Mission to Enablers

Other Law Enforcement			Plans and Partnerships		Infrastructure						Response Capabilities		Information	Vehicles				
Outcomes	**Accomplishments**	**Activities**	Policies and plans for Arctic operations and emergent situations	Local, state, federal, international, and public-private partnerships	Communications infrastructure	Logistical infrastructure	Coastal infrastructure	Navigational safety infrastructure	Forward operating locations	Medical trauma care facilities	Specialized environmental response capabilities	Deployable operations teams	Domain awareness technology	Icebreakers	Non-icebreaking, cold-weather-equipped vessels	Fixed-wing aircraft	Rotary-wing aircraft	Unmanned aerial vehicles
1. Enforce U.S. Exclusive Economic Zone (EEZ)	1.1. Deter illegal foreign fishing in the U.S. EEZ	1.1.1. Maintain effective presence to deter prospective EEZ violations				X	X		X				X	X	X	X	X	X
		1.1.2. Publicize the risks and costs of committing EEZ violations		X														
	1.2. Counter illegal foreign fishing in the U.S. EEZ	1.2.1. Monitor for and detect foreign ships illegally fishing in the U.S. EEZ											X		X	X	X	X
		1.2.2. Intercept and interdict foreign fishing vessels				X		X	X			X	X		X			
		1.2.3. Board, apprehend, collect evidence regarding, and cite foreign fishing vessels				X		X	X			X	X		X			
		1.2.4. Prepare case packages for prosecution, as appropriate																
2. Enforce adherence to international fishing regulations	2.1. Prevent violations of international fishing regulations	2.1.1. Continue and expand effective partnerships to improve partner capabilities and information sharing		X	X													
		2.1.2. Maintain effective presence to achieve awareness and to deter prospective violations of international regulations by demonstrating ability to enforce them		X		X	X		X					X	X	X	X	X
		2.1.3. Document and respond to violations of international fishing regulations--disrupt, intercept, interdict, board, apprehend, cite, and/or prepare case packages for prosecution, as appropriate	X		X	X			X			X	X		X	X	X	X

Appendix C. Full Description of Workshop I

In this appendix, we discuss the approach taken in and results from Workshop I. We begin with Table C.1, which summarizes key similarities and differences between Workshops I and II.

Table C.1. Comparison of Workshops

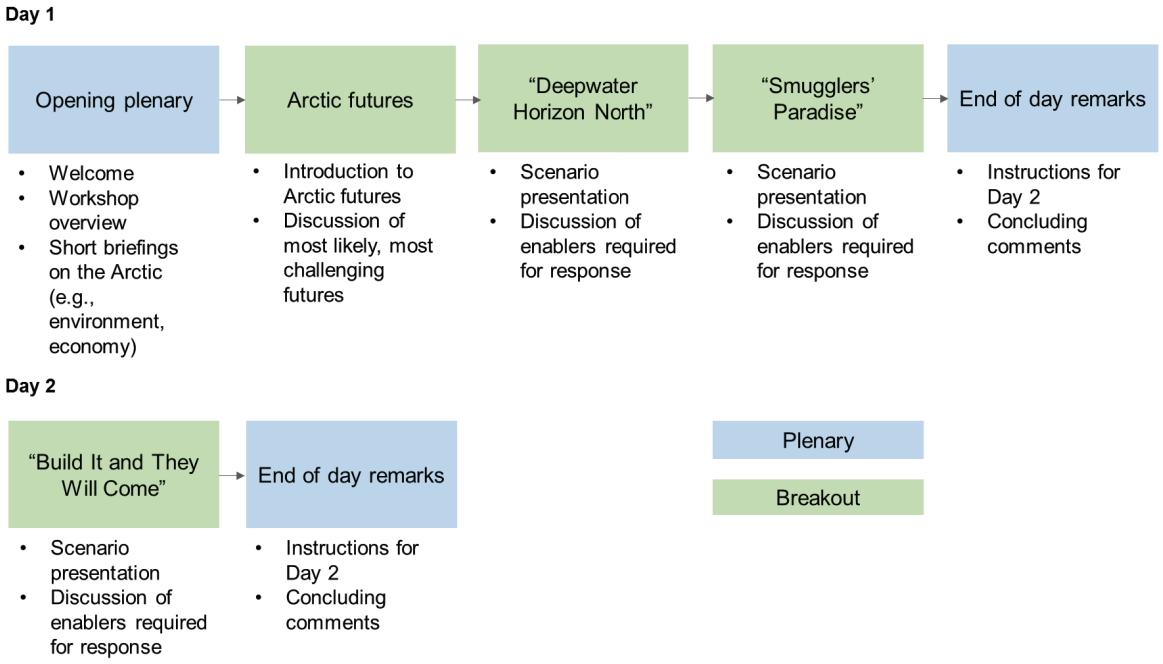
Characteristic	Workshop I	Workshop II
Date and location	May 11–12, Fairbanks, Alaska	September 25–26, Washington, D.C.
Objective	*Examine possible future Arctic conditions along several dimensions, discern mission requirements, identify needed response capabilities, and uncover associated science and technology—and any associated policy—gaps and shortfalls*	*Identify and characterize potential gaps in USCG Arctic response capabilities over the next few decades, and ways in which to remediate those gaps through investment, partnerships, and long-term planning*
Participants (number)[a]	DHS, state of Alaska, local community, and other partners (50–70)	Primarily DHS and USCG operators and planners (25–35)
Breakout session focus areas (number of each type)	Futures (1), scenario response (3)	Scenario response (4), findings (1)
Scenario events discussed[b]	"Deepwater Horizon North," "Smugglers' Paradise," "Build It and They Will Come"	"Deepwater Horizon North," "Smugglers' Paradise," "Build It and They Will Come," "Bump," "Over the Top," "Small Ships, Big Problems," "Storm Front," "Icy Standoff," "Cyber Lights Out," "Fish Fight," "Cold Terror"
Structure of scenario-focused sessions (numbers indicate order of events within breakout session)	1. Scenario presentation; 2. Operating concept discussion; 3. Individual allocation of points to enablers; 4. Group discussion; 5. Opportunity for individuals to redistribute enabler points	1. Scenario presentation; 2. Discussion of key assumptions, measures of success, and operating concept; 3. Individual designation of specific assets as critical, important, or unimportant to response; 4. Group discussion; 5. Opportunity for individuals to alter designations for specific assets and suggest modifications and additions; 6. Group discussion of modifications and additions; 7. Group prioritization of top three modifications and enablers
Focus of data collection	List of 16 broad enabler types across which each participant distributed 100 points based on importance to response	List of 51 current or planned assets that might be used in the Arctic and were labeled by participants in terms of importance and needed additions or modifications
Types of results	Prioritized Arctic futures based on which were most likely and most challenging (respectively), distribution of points among enabler types, discussion points	Prioritized asset and enabler additions and modifications needed to improve scenario responses, compiled potential capability gaps, favorability of assets, discussion points

[a] Number varied based on the availability of participants to join the workshops in their entirety.
[b] Each event was situated within a consistent future; futures varied according to the factors introduced in Chapter 2. Futures appeared to have minimal impact on workshop discussions—which is why they are not called out in this table for the primary purpose of simplicity—with the exception of whether international partner capabilities were available or not based on broader geostrategic conditions.

Approach

Workshop I yielded useful insights on both Arctic futures and enablers. It also enabled us to explore workshop methods, which resulted in helpful lessons that enabled refinement of the approach in preparation for Workshop II. The flow of events in Workshop I is summarized in Figure C.1.

Figure C.1. Summary of Workshop I Flow



The purpose of the initial plenary was to welcome participants and provide a series of short briefings covering different aspects of the Arctic, including environment and economy, in order to ensure that our diverse set of stakeholders—which included DHS and USCG planners and operators, state of Alaska and indigenous community representatives, partners from other federal agencies, scientists and academics, and others—would have the same set of baseline facts to consider as part of the subsequent breakout session discussions.

The first breakout session was explicitly focused on the discussion of alternative Arctic futures, which were derived from some of the future state narratives described in Appendix A. The goal was to identify stakeholder perspectives on which of the factors discussed in Appendix A (e.g., economy, domestic society, international security and geopolitics) would potentially drive change in the Arctic, what those changes might look like, and how changes would impact DHS roles in the region. Participants were asked to first discuss the implications of four alternative futures described to them based on the factors characterized in Appendix A. Half of the participants focused on security and social factors (Group A), with futures including

- "Business as Usual" (increased maritime access supports modest economic growth)
- "Increasing Disorder" (regulations loosen, people on the move)
- "Breakdown in Cooperation" (international Arctic ties weaken)
- "Every Country for Itself" (rapid economic, social, and regulatory changes break Arctic ties).

The other half (Group B) focused on economic and regulatory factors, with futures including

- "Business as Usual"
- "Structured Boom" (measured economic growth draws people north)
- "Arctic Wild West" (advances in technology and increasing demand boost industry)
- "Every Country for Itself."

The first and last future examined in each group overlapped because these applied to both focus areas and represent two extremes: The former is a future in which the Arctic of the 2030s has made predicable progress along trends forecast in 2017, whereas the latter is a future Arctic in which things are very different along each of the four dimensions examined (security, social, economic, regulatory). These futures were selected for the workshop in coordination with the project sponsor and DHS stakeholders that were not involved with the workshop as participants. These futures were not intended to be prescriptive nor were they characterized as the only futures that might come to pass; rather, we considered these futures to be useful instruments by which to encourage and structure discussion. Environmental change and infrastructure (both mobile and fixed) were presented as a series of fixed assumptions in order to focus discussion on other factors of interest, in line with sponsor preferences and what was manageable within the span of one breakout session.

After general discussion of the different futures, participants were given a worksheet on which they were asked to rank the different futures by how plausible they appeared, followed by a separate ranking for how challenging they would be for DHS operations. Participants filled these worksheets out individually before engaging in group discussion. Participants were permitted to change their answers on the basis of the group discussion, if desired. Only the final answers were recorded.

The second, third, and fourth breakout sessions were all focused on specific scenarios; that is, particular events that DHS would have to respond to occurring within the context of a specific future. In order of presentation, the scenarios—which were set in the 2030s—included the following:

1. "Deepwater Horizon North" occurring in the "Arctic Wild West," in which an offshore oil rig with people on board explodes in a world of increasing economic activity and uncertain regulations
2. "Build It and They Will Come" occurring in a "Structured Boom," in which a deepwater port is constructed in a world with enhanced economic activity held in check by firm regulations
3. "Smugglers' Paradise" occurring within "Increasing Disorder," in which illicit substance and human trafficking increases substantially in a world of modest economic growth,

population increases, some uncertainty in regulations, and a loosening of international ties.

Please see Appendix A for additional details about these events and futures. These particular scenarios were selected based on sponsor and DHS stakeholder preferences to investigate scenarios with key differences, including involvement of various DHS components, timelines for response, and response emphasis (e.g., medical and environmental emergency vs. illicit activity and law enforcement).

Once scenarios were presented, participants were asked to distribute 100 points of "purchasing power"[61] among the following 16 enablers:

- icebreakers
- nonicebreaking, cold-weather equipped vessels (e.g., cutters)
- fixed-wing aircraft
- UAVs
- rotary-wing aircraft (helicopters)
- specialized environmental response capabilities (e.g., oil spill response, hazardous materials response)
- domain awareness-gathering technology (data buoys, satellites)
- navigational safety infrastructure
- coastal infrastructure
- communications infrastructure
- forward operating locations
- logistical infrastructure
- medical trauma care facilities (levels I–V) and airborne ambulatory services
- deployable operations teams
- local, state, federal, and international partnerships
- policies and plans for Arctic operations and emergent situations.

For simplicity, we did not vary the order in which enablers were presented on participant worksheets, although this could further strengthen the methodology in a future event. These 16 enablers were put together after reviewing logic models[62] that detail the activities or functions conducted by the USCG, as well as current USCG assets and approaches to response. Although logic models were not available for other DHS components, we reviewed their respective mission statements in detail. By examining these materials, we were able to roughly characterize the different types or "bins" of enablers that could be required for scenario response, noting that some enablers depend on each other (e.g., vessels rely on coastal and navigational safety infrastructure) and others at first glance appear to be unlike types. For example, UAVs are a type of asset, while domain awareness-gathering technology is closer to a capability. However, UAVs

[61] Participants were asked to focus on the importance of a particular enabler, not the cost, so the point distributions did not reflect the cost of an enabler unit.

[62] Savitz et al., 2015.

can carry sensors that fall under the capability category. Analysis of how enablers may be important for facilitating activities within USCG logic models can be found in Appendix B.

These enabler types were used for convenience, given the very diverse set of participants present at the workshop. Any challenges associated with dependencies or differences in type were largely overcome by the workshop instrument design, which allowed participants to distribute their 100 points flexibly, and participants were reminded to "invest" in enablers that necessarily had to go together in order to facilitate a particular scenario response (e.g., to "purchase" UAVs alongside domain awareness-gathering technology if persistent surveillance was key to the response).

Following an initial round of individual point distribution, participants discussed a response approach (what could be thought of as a start to a concept of operations) as a group, while ADAC student fellows recorded initial point distributions among enablers on a spreadsheet. This enabled rapid tabulation of the average number of points given to each enabler. Based on these averages, enablers were ranked from highest to lowest and written on a whiteboard in that order for the group to see. Breakout group facilitators used various techniques for stimulating discussion about the importance of and linkages between various enablers. One technique involved drawing a line between the top eight enablers and the bottom eight and asking participants to consider whether they could conduct the scenario response with just the top eight enablers. If not, then what needed to be changed? Another technique involved the facilitator starting at the bottom of the list and, going one by one, asking participants to discuss whether each enabler was needed and why. Flexible discussion techniques were discussed and agreed upon among facilitators prior to the workshop and were used to ensure that breakout group dynamics could be taken into account in deciding which method was best in a particular context. Regardless of method, the primary purpose of the discussion was to enable participants to weigh the importance of each enabler before returning to their worksheets to redistribute their 100 points. In some cases, the point distribution for individual participants did not change, but in many cases, it did. The second round of point distributions was also recorded in a spreadsheet for analysis.

At the end of each day, participants were invited to sit in plenary for a short period. General remarks were provided, along with a brief conclusion at the end of Day 1.

Results

During the first day of the workshop, we calculated the results from how participants ranked the different futures in terms of how plausible and challenging they were, respectively. For this basic analysis, we converted the ranks given by participants into points (e.g., "most plausible" from a particular response was given four points, whereas "least plausible" was given one point). These results are summarized in Table C.2.

Table C.2. Workshop I Results for Futures

Group and Rating Focus	Futures Ordered from "Most" to "Least"
A – How plausible are futures	1. "Business as Usual" 2. "Breakdown in Cooperation" 3. "Increasing Disorder" 4. "Every Country for Itself"
B – How plausible are futures	1. "Every Country for Itself" 2. "Increasing Disorder" 3. "Breakdown in Cooperation" 4. "Business as Usual"
A – How challenging are futures	1. "Structured Boom" 2. "Business as Usual" 3. "Arctic Wild West" 4. "Every Country for Itself"
B – How challenging are futures	1. "Every Country for Itself" 2. "Arctic Wild West" 3. "Structured Boom" 4. "Business as Usual"

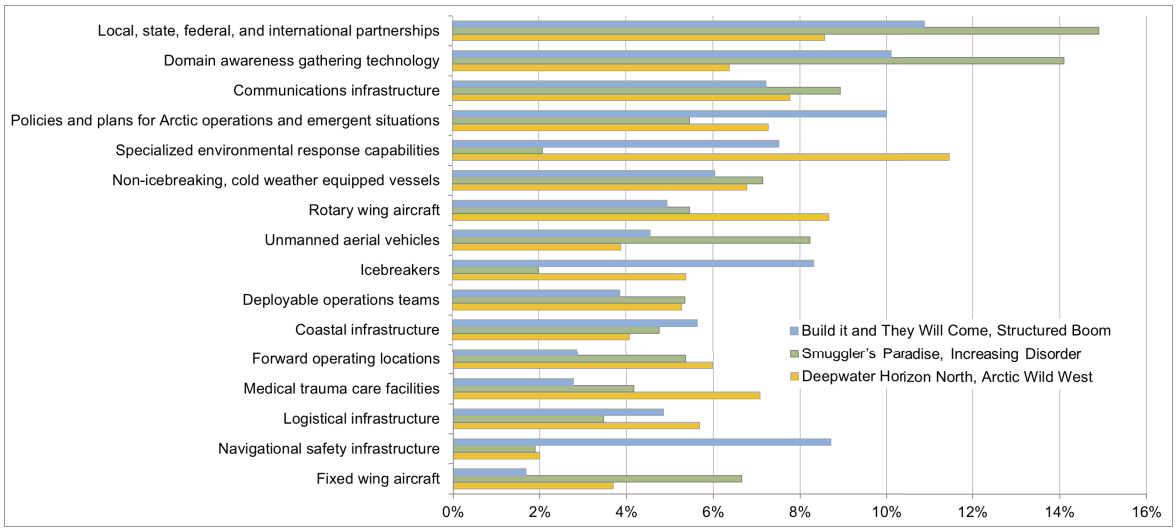
Most participants felt that change along all four dimensions examined in the "Every Country for Itself" future would be the most challenging future, and also the least plausible. "Business as Usual" was considered both plausible (though not the most plausible in the results from Group B) and the least challenging future. Those in Group A saw a breakdown in international cooperation as both slightly more plausible and slightly less challenging than a loosening of international ties along with changes in regulations and more movement of people. Overall, participants seemed to find change along more dimensions both less plausible and more challenging than futures with more elements common to 2017 trends and patterns. This is not surprising, since radical change is both difficult to predict and challenging to respond to, whereas a continuation of present trends is exactly the opposite, especially since present-day government policies, plans, systems, and other entities tend to be geared toward operating in response to current trends. However, we did not examine agreement and disagreement between participants on the relative ranks of the futures, so these results can only be considered as exploratory.

Following the workshop, we tabulated the average number of points given by individual participants to each enabler in breakout sessions 2–4 before (round 1) and after (round 2) the group discussion about response approach and the average breakout group results from round 1. Figure C.2 summarizes these results for the three scenarios, respectively.[63] Despite some commonalities, *the enablers needed for different futures and scenarios varied considerably*. For example, navigational-safety infrastructure was viewed as important in addressing a structured boom for the "Build It and They Will Come" future, but of negligible utility in addressing a major oil spill in an "Arctic Wild West" or a smuggling challenge in an increasingly disorderly

[63] Participants were allowed to allocate points twice (initially, and then after group discussion). This figure reflects the results following group discussion.

region. The perceived need for deployable teams, specialized environmental capabilities, and other enablers also varied widely among scenarios and futures. This variability of participant preferences by scenarios makes some sense, especially for enablers like environmental response assets that could be less broadly applicable. Overall, it does appear that *domain awareness-gathering technology and partnerships were somewhat consistently favored*, but it is difficult to draw any firm insights from the figure below besides the apparent scenario-dependence of participant preferences.

Figure C.2. Percentage of Points Allocated Across Different Enablers



Further, no enabler received less than 5 percent of points across all three scenarios, which could reflect the diversity of elements required in response. Logistical and coastal infrastructure and forward operating locations consistently received low allocations of points. This could be, in part, because of confusion regarding what these categories of enabler contained and a tendency of participants to focus more on the immediate mechanics of response and less so on support and sustainment functions.[64]

Interpreting Results from Workshop I

The precision resulting from the individual ranking process does not have sufficient fidelity to be relied on for policymaking. Therefore, we used a clustering algorithm to identify appropriate cutoffs for enablers that are collectively critical, important, or less important. We did

[64] Having facilitators provide more emphasis on a holistic response approach may have helped, although it is interesting to note this pattern in participant choices, which was not repeated in Workshop II. Participants in Workshop II consistently had more experience as USCG operators than those in Workshop I and clearly raised issues having to do with both coastal and navigational infrastructure (which were also more clearly represented through the use of a workshop instrument that called out specific assets instead of generic enablers).

this by conducting a hierarchical clustering on the overall point allocation made by our participants. Before running the clustering, we normalized the point allocations across sessions (e.g., based on number of participants, Session 2 had 5,000 total available points, Session 3 had 4,200, and Session 4 had 3,700). This analysis distributed enablers among three tiers, as follows:

- **Tier 1**
  - domain awareness-gathering technology
  - local, state, federal, and international partnerships
- **Tier 2**
  - communications infrastructure
  - nonicebreaking, cold-weather-equipped vessels
  - policies and plans for arctic operations and emergent situations
  - rotary-wing aircraft
  - specialized environmental response capabilities
- **Tier 3**
  - coastal infrastructure
  - deployable operations teams
  - fixed-wing aircraft
  - forward operating locations
  - icebreakers
  - logistical infrastructure
  - medical trauma care facilities
  - navigational safety infrastructure
  - UAVs.

This may summarize what was on participants' minds during the workshop with respect to what they thought was needed to respond to Arctic scenarios. However, when interpreting these results, it must be borne in mind that the particular way in which we created enabler categories—and participants' understanding of them—impacted the results. For example, the decision to not combine domain awareness-gathering technologies with the assets that can carry them, along with the choice to separate fixed infrastructure from the types of assets that depend on it, forced participants (to some extent) to choose among enablers that really belong together.[65]

We were also interested in how consistently particular enablers were favored or not deemed important across participants in different scenarios. For this, we calculated the coefficient of variation for points distributed to each enabler within a particular scenario. We used a threshold

[65] Also, it may have been easier for some participants to interpret what certain enablers would include, leading to responses that favored enablers participants were more familiar with. This was not something the research team anticipated and would have mitigated with information sheets providing examples of assets each enabler includes, as well as a reminder that conducting operations often requires multiple types of enablers, both fixed and mobile.

value of 0.5 or below to indicate a firm level of group consensus,[66] which happened extremely rarely in our analysis. Many enablers had coefficient of variation values above 1 in at least one scenario, suggesting no consensus.[67] This is probably due to not having more rounds for deliberation and the diverse variety of stakeholders with differing levels of operational experience.

There were a few exceptions in which there was consensus, based on our analysis of point distribution coefficient of variation. Communications infrastructure (scenario 1), domain awareness-gathering technology (scenario 2), and both partnerships and domain awareness-gathering technology (scenario 3) achieved this threshold. We felt that the number of participants in each breakout group was too small to derive reliable meaning for a statistic such as the coefficient of variation. Therefore, we were not able to examine whether individual breakout groups achieved consensus.

We also distilled the notes taken by student ADAC fellows and our facilitators during each breakout session to search for common themes and ideas. We did this by tagging individual notes with words and phrases that were broad enough to enable merging but specific enough to derive particular ideas. This involved an iterative process, by which notes that had already been reviewed and tagged could be re-tagged as new information categories emerged. Using the tags, comments with like themes were compiled together and reviewed in order to articulate the main point of content within a single sentence. Below, we include frequently arising themes; the complete summary of workshop notes can be found at the end of this appendix:

- Cooperation is crucial for ensuring ability to conduct response, and included interdepartmental, interagency, intergovernmental, industry, and native community partnerships.
- The need for response plans should be effectively communicated to Congress and headquarters.
- Real-time domain awareness is needed, along with an ability to fuse and analyze data from different sources.
- Large communications gaps are exacerbated by the use of varied, incompatible systems.
- In an emergency, persistent on scene presence is important for responding, which can include Arctic-capable aircraft and cutters; locations within the region and industry self-help capabilities are important.
- There is need for increased focus on Arctic oil spill response, but industry should play a large role in this.
- Deepwater ports will be necessary to support increased activity (and may be a catalyst for change).
- Icebreaking capability is important, but a heavy icebreaker may not be required.

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[66] Heiko A. Von der Gracht, "Consensus Measurement in Delphi Studies: Review and Implications for Future Quality Assurance," *Technological Forecasting and Social Change*, Vol. 79, No. 8, 2012, pp. 1525–1536.

[67] Sema A. Kalaian and Rafa M. Kasim, "Terminating Sequential Delphi Survey Data Collection," *Practical Assessment, Research, and Evaluation*, Vol. 17, No. 5, January 2012.

- Organizations conducting illegal activities are more likely to accept a higher level of risk in their Arctic operations.
- Containment and security are primary activities for response to events like oil spills, terrorism, and drug or human trafficking.
- The United States is reliant on the support of other nations in the Arctic; plans should take into account the need to maintain those partnerships and/or develop more-robust organic capabilities.
- There are useful lessons to be drawn from experiences of economic development and other change, historically and around the world.

These discussion highlights are consistent with the semiquantitative results but also have somewhat different emphases, making these a useful complement to the other results.

Collectively, these results produced the following key findings that provided evidence in support of the capability gaps discussed in Chapter 5:

- It is unclear which futures could be most plausible and which would be most challenging, so bearing in mind a variety of outcomes and implications will be important for planning.
- Policies, plans, and partnerships—in addition to materiel assets—are important components in developing a successful Arctic capability portfolio.
- Domain awareness is a persistent need—and challenge—across multiple types of operations.
- No single type of materiel asset can be inserted to fix Arctic challenges; rather, a portfolio approach in which due consideration of how assets and enablers work together to facilitate Arctic operations could be more appropriate.
- Incident prevention (e.g., through the further development and enforcement of regulations) and availability of mechanisms that can be locally employed on scene (e.g., oil response and medical emergency kits on ships) are also important aspects to bear in mind when considering the development of an Arctic capability portfolio.

Workshop I also resulted in insights that aided the tailoring of Workshop II to focus directly on potential capability gaps. First, we recognized that we needed to both articulate enablers in more-specific terms (i.e., not generalize through broad categories) and include a large number of operators who would be able to speak to the differences between specific helicopters or radios, for example. Second, we determined that it was also important to include many scenarios and enable participants to voice any additional assumptions they felt needed to be articulated in order to illustrate how a response might be conducted. Finally, we felt it was important to allow participants more time to acclimate to the workshop format, given that our approach was new.

Additional Information: Recurring Themes in Workshop I

Notes from the workshop were reviewed multiple times by one analyst (who was at the event) to explore recurring themes, which were identified manually on the basis of repeated words or phrases relevant to common topics. Once the list of themes was collated, further examination of the notes brought together a more thorough description from all the discussions

focused on that particular theme. For organizational purposes, these "recurring themes" are grouped into the following categories:

- partnerships, policies, and plans
- timely and accurate information fused from multiple sources
- physical assets, capabilities, and infrastructure
- contextual indicators and nontraditional stakeholders.

Here, we report the recurring themes (in no particular order) within each category:

- **Partnerships, policies, and plans**
  - **Partnerships.** Partnerships and cooperation are crucial. In every scenario, they were repeatedly brought up as critical. When the scenario indicated that those partnerships were no longer valid, nearly every group agreed that recreating them was a critical first step. This theme includes (but is not limited to) interagency, interdepartmental, intergovernmental, international, and industry.
  - **Arctic cooperation.** Historically, the Arctic has remained fairly cooperative even during high tensions elsewhere. The recent buildup of infrastructure and persistent presence of the Russian military could mean a marked departure from that historical peace and would have significant implications on what the USCG would be required to provide in its military capacity and which would require DoD bolstering on a level it is not prepared to handle (capability and capacity—gray hulls cannot operate with ice, and U.S. ground forces have little to no Arctic sustainment capability).
  - **Streamline.** Streamlining current processes and information sources is important. There is significant overlap and yet significant gaps still persistent.
  - **Industry capability and regulation.** Industry capability and regulation must reflect the lack of presence and capacity of DHS in the region. Capability to self-rescue, deal with an environmental hazard, and bolster the infrastructure needed for communications and logistics had to be driven and supported by industry. Additionally, regulations requiring and enforcing these capabilities and responsibilities must be in place.
  - **Clear paths and plans.** Infrastructure and clear lines of responsibility for detaining smugglers are necessary Massive detainment structures are not required as sometimes even the vessel itself can be used as a de facto brig, but in remote areas where infrastructure is lacking, there need to be clear plans and paths of movement or handoffs of responsibility.
  - **International dependencies.** We are currently highly reliant on other nations' support and cooperation for assistance in the Arctic. We need either to plan to keep those robust and reliable or to develop and fund the capabilities and capacity required to be independent.
  - **Policies and plans.** Communicating to headquarters and congressional levels what is truly likely to happen (and the consequences of not planning for it) is critical to every capability, capacity, and effective response in every scenario.
  - **Industry partnerships.** Government ownership is not always required. But partnerships and very clear requirements would need to be strong, and limitations very well understood. (For example, if relying on industry to have some SAR

responsibility, will they be trained and required to put themselves at risk to go out in extreme weather the way the USCG would?)

- **Timely and accurate information fused from multiple sources**
  - **Fusion center.** This includes correlation and integration of information, intelligence, assets, agreements, command and control, enforcement, assignment of duties, etc. Something akin to Joint Interagency Task Force South (that integrates at the local community and state level as well) would be immensely beneficial for this region with so little capability resources and disproportionately reduced capacity when compared with the lower 48 states.
  - **Maritime domain awareness.** Maritime domain awareness is critical—specifically real-time maritime domain awareness. The commercial industry has a fairly good grasp of this currently (for cooperative vessels with transponders) and does a decent job bringing together multiple sources of information. However, this does not apply to much of the coast, local fishing populations, or dark vessels.
  - **Information and intelligence.** These are crucial first steps in everything. Nothing can be done without the right information and the ability to disseminate it to the responders.
- **Physical assets, capabilities, and infrastructure**
  - **Icebreaking.** Icebreaking capability is crucial, but a heavy icebreaker possibly is not needed in many relevant circumstances. As the routes open up, there will be less (and thinner) ice. However, it is likely that traffic will push further into the shoulder seasons, which will still require the capability to deal with ice. Ice-hardened hulls are a worthwhile consideration, but actual icebreakers will be required in the shoulder seasons.
  - **Robust communications.** A more robust communications network is necessary. Large gaps and varying types and systems will be a significant hindrance to awareness and the ability to respond.
  - **Persistent on scene presence.** Forward operations are vital for responding to an emergency. They can include UAVs, cutters, and aircraft. If an on scene response is needed within a few days, a cutter (or icebreaker) needs to be nearby. The others are imperative for accurate sources of information for the land-based components to plan and react, but will not suffice in a rescue or immediate response to a spill. That level of immediate response will only come from luck of location or industry self-help capability.
  - **Deepwater port.** Deepwater ports will be necessary for increased shipping, logistics infrastructure, etc. Many existing ports have degraded over time, and information on depth and condition is often inaccurate. The development of deepwater ports might itself be a catalyst for change and growth in the area.
  - **Infrastructure increase.** Increase in infrastructure is a double-edged sword. It will enable more effective and efficient actions, but also facilitate illicit movements.
  - **Accurate assessment of current infrastructure.** Infrastructure needs to be mapped, and there must be awareness of likely changes and degradations to come with the changing environment (e.g., road collapse due to melting permafrost).

- **Containment and security.** These are primary factors for response to events like oil spills, terrorism, and drug or human trafficking.
- **Medical facilities.** An increase in medical care facilities is not part of the DHS concern, but DHS needs to be able to work with them logistically.
- **Environmental clean-up.** The USCG contracts out most clean up. It does have some response capabilities that could benefit the spill early if prepositioned, but DHS should not be focusing on the ability to clean up so much as the regulation and requirements of the industry to do so. However, there is a need to develop a response to clean up a large oil spill offshore.
- **Ruggedize current capabilities.** Many current capabilities need to be "ruggedized" for the Arctic, but not necessarily reinvented. Fixed-wing aircraft need heated wings. Hulls need to be at least ice-hardened, if not icebreaking. Deployable operations teams exist, but the equipment is not Arctic-capable and personnel are not trained for extreme cold, etc.
- **Increased risk in the Arctic.** Illegal activities are likely to accept higher risk (e.g., go through ice that is too thick for their structure, ignore extreme weather alerts), which will put the rescue and enforcement aircraft and vessels in higher-risk situations as well. Capabilities need to be built with that in mind and not the average or lower-risk scenarios.
- **Integrated and Arctic-focused approach in acquisitions.** Many "up and coming" unmanned technologies might be efficient and effective in expanding the USCG reach (especially in a supplemental form), but there needs to be an integrated and Arctic focused approach, not just bringing up new tech designed for southern waters and mild weather.
- **Climate change effects on infrastructure.** The melting of permafrost and the volatility of the region's geology and hydrology has significant resulting effects on infrastructure (e.g., roads, buildings, pipelines, other shoreline and tidal structures). Permafrost changes, melting ice and changing ice properties, and free ice impact coastal communities and infrastructure. In addition to these effects, the stark seasonal variability makes temporary infrastructure potentially more feasible than permanent infrastructure.

- **Contextual indicators and nontraditional stakeholders**
  - **Historical lessons** can be learned from situations here and across the world. These include the Arctic gold rush at the turn of the twentieth century, the Australian mining industry, Cold War–era interactions, the oil boom of the 1980s, and the current oil boom in North Dakota.
  - **A population increase** has significant potential, but it is often agreed that it will not come in the form of booming communities, but instead in the form of isolated man camps (and non-U.S. labor), which will cause their own set of law enforcement challenges. The increase will create economic opportunities for local communities, but also tensions.
  - **Local communities.** Integration and cooperation with local communities is beneficial on many levels. These ranged from having a local as a Customs and Border Protection officer in a small community, who would serve as the "first line" response to illegal materials coming on shore, to cultural implications of adding infrastructure.

Local communities also could have the ability to independently affect international influence by cooperating with outside stakeholders if they feel the United States is not meeting their needs.

- **"Business as usual"** might be the most challenging scenario, because nothing will drive change or advancement in any capability, capacity, or plan. Every other future has some sort of catalyst, which has the potential to bring about change that can drastically affect each of the scenarios. Alternatively, this scenario might be the least challenging because it might have the least external pressures likely to be the catalyst for a catastrophic event.
- **Illegal substance increase.** Drugs are already a substantial challenge for Alaska, and the state is not set up for a "war on drugs" like the lower 48. While it is high risk and high cost to import drugs, the risk and cost will decrease while demand will likely stay steady or rise, especially if the population increase is in the form of man camps and rotating personnel not invested in a local community.
- **Non-Arctic nations.** These will be a factor. Knowing who the stakeholders are and where their interests, priorities, capabilities, and risks are will be crucial to awareness of the domain and where the impacts and risks will likely emanate from.

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A key Arctic strategy and planning challenge for the Department of Homeland Security (DHS) and the U.S. Coast Guard (USCG) is how to enhance activities to prepare for operations before a crisis comes to pass. The USCG Arctic Strategy has been instrumental in developing some momentum for USCG and DHS planning in the region, but may require updating in light of continuing transformations in the Arctic region. Another important step in planning will involve the development of a new Arctic Capabilities Analysis Report (CAR), one type of planning document within the broader DHS Joint Requirements Integration Management System process. The research described in this report focuses on articulating potential Arctic capability gaps in 2017 and the 2030s. It was designed to provide information for a forthcoming USCG Arctic CAR. As such, it includes some aspects of a capability analysis, such as the identification of necessary, high-level capabilities; articulation of links between capabilities and missions; and documentation of potential capability gaps. Although previous reports and statements have articulated Arctic needs, challenges, gaps, and vulnerabilities, this new work provides a fresh look at potential gaps using a structured, traceable approach that considers a broad spectrum of contingencies that DHS might have to respond to in the Arctic.