ARCTIC MARITIME & AVIATION
TRANSPORTATION INFRASTRUCTURE INITIATIVE

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ICELANDIC COAST GUARD

Table of Contents

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INTRODUCTION TO AMATII

The Arctic Maritime and Aviation Transportation Infrastructure Initiative (AMATII) serves as an initial platform for inventorying critical assets in the Arctic's aviation and maritime environment. The Initiative facilitates ongoing and increased communication and collaboration throughout the Circumpolar North. It serves as a coordination point for future research and has the potential to facilitate technology transfer within the Arctic region.

AMATII builds on and responds to past efforts and projects of two working groups within the Arctic Council—the Protection of the Arctic Marine Environment's 2009 Arctic Marine Shipping Assessment Report and the Sustainable Development Working Group's Circumpolar Infrastructure Task Force (CITF), which hosted the Arctic Aviation Experts conferences in 2005 (Khanty-Mansiysk, Russia) and 2006 (Winnipeg, Manitoba, Canada). More directly, it follows on the strategic plan set forth at the 2010 Arctic Aviation Experts Conference (AAEC) in Fairbanks, Alaska.

The need for expanded sea and air response capacity corresponds to several factors, including increased resource extraction to support economic and community development; increased shipping traffic through the Northern Sea Route; increased activity in the Canadian Arctic, including the Northwest Passage, to support marine operations like community resupply; and increased cruise ship traffic.

Transportation infrastructure is a critical component of sustainable development and strengthens the resiliency of Arctic communities. AMATII assumes that response is most effective when addressed through a strategic, intermodal approach that includes marine and air assets. The project focuses on Arctic transportation infrastructure, which functions as both gateway to and anchor for response capability in support of search and rescue (SAR); resource extraction and development activities; pollution prevention and environmental safety; and community health and security.

For the purposes of this initiative, very basic definitions were used. "Port" denotes maritime infrastructure and, in some cases, Arctic nations chose to list community sites where re-supply occurs, not just those locations where full port facilities are present. Similarly, "airport" denotes aviation infrastructure, excluding private and abandoned runways, but may include aerodromes, commercial airports and others as supplied by individual nations.

DELIVERABLES

- An ***Arctic Maritime and Aviation Infrastructure Database***, a web-based, searchable inventory of baseline public port and airport data;
- An ***Arctic Maritime and Aviation Infrastructure Map*** that hosts layers of port and airport infrastructure for a graphical representation of asset locations; and
- A ***Guidance Document***, which includes the proceedings of the Port and Airport Infrastructure Workshop, as well as case studies and illustrative stories of northern aviation and maritime infrastructure.

Each nation defines "Arctic" differently. Thus the database has examined maritime and aviation infrastructure within each nation's parameters (please refer to Appendix C: Workshop Materials, Project-related Terminology).

The database, map and guidance document provide a credible and accessible source of data about northern transportation infrastructure. Deliverables illustrate existing infrastructure and provide a broad perspective from which to identify policy-relevant conclusions in support of Arctic strategies.

This document reflects proceedings of a workshop held in December 2012 and, as such, the contents provide guidance. Any language used herein is not prescriptive.

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ABBREVIATIONS AND ACRONYMS

AAEC – Arctic Aviation Experts Conference
ADS-B – Automatic Dependent Surveillance - Broadcast
AIP – Aeronautical Information Publication
AIS – Automatic Identification System
AMATII – Arctic Maritime and Aviation Transportation Infrastructure Initiative
AMSA – Arctic Marine Shipping Assessment
ATS – air traffic services
AUV – autonomous underwater vehicle
CAFF – Conservation of Arctic Flora and Fauna (Arctic Council working group)
ECA – Emission Control Area
EEDI – Energy Efficiency Design Index
EMT – emergency medical technician
FAA – Federal Aviation Administration
GAA – Greenland Airport Authority
GBT – ground-based transceiver
HIFR – Helicopter In-Flight Refueling
ICAO – International Civil Aviation Organization
ICG – Icelandic Coast Guard
IMO – International Maritime Organization
ISPS – International Ship and Port Facility Security [code]
JRCC – Joint Rescue Coordination Center
LRIT–- long-range identification and tracking
NM – nautical mile
NSR – Northern Sea Route
PAME – Protection of the Arctic Marine Environment (Arctic Council working group)
PPP – public-private partnership
RCC – Rescue Coordination Center
SAON – Sustaining Arctic Observing Network
SAR – search and rescue
SDI – Spatial Data Infrastructure
SDWG – Sustainable Development Working Group (Arctic Council)
UAV – unmanned aerial vehicle
USCG – United States Coast Guard

Arctic Transportation Infrastructure Workshop

EXECUTIVE SUMMARY

The Arctic Council's Sustainable Development Working Group approved a project (co-led by the United States and Iceland) during the Swedish Chairmanship to assess transportation infrastructure. The Arctic Maritime and Aviation Transportation Infrastructure Initiative (AMATII) helps decision-makers evaluate northern infrastructure—ports, airports and response capability—by inventorying maritime and aviation assets in the Arctic.

As part of this project, the Institute of the North hosted the Arctic Transportation Infrastructure Workshop in Reykjavik, Iceland, with the theme, "Response Capacity and Sustainable Development in the Arctic." The theme reacts to the search and rescue agreement undertaken by the Arctic Council, as well as recent efforts by its Task Force on Arctic Marine Oil Pollution Preparedness and Response, which have caused a re-examination of response capacity. To adequately address sustainable growth in light of increased traffic and resource development, the workshop looked at the future. What infrastructure is in place and what is needed? After these initial phases, how can we work collaboratively across the Arctic to employ best practices and leverage existing and future assets for maximum capacity?

Participants included policy makers and government officials, and aviation and marine subject matter experts from the private, public, independent and academic sectors. Arctic experts met in both plenary and work sessions to discuss infrastructure vis-à-vis response, technology and investment. Participants viewed and commented on the Arctic Maritime and Aviation Infrastructure Database and web-based map, primary deliverables of this project. In addition, the workshop crafted a unique opportunity for dialogue between technical and policy experts, resulting in a robust discussion of how transportation infrastructure is a critical building block of sustainable development.

Discussion throughout was wide-ranging and informative, though by no means comprehensive. The proceedings from the workshop illustrate the complexity of the topic. The AMATII database had always been envisioned as an ongoing project and participants confirmed the work to be done. Baseline data serves as a necessary first step in the process and the product is a visible, tangible expression of the priority placed on critical infrastructure in the North. Workshop attendees emphasized this as well.

Much of the discussion focused on future increases and growth. However, it is important to recognize the urgent need to maintain and sustain the current infrastructure that supports Arctic communities in the face of climate change factors like permafrost degradation.

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GREENLAND AIRPORT AUTHORITY

Additional considerations for the future were discussed, including common international standards in ice expertise for marine navigators and/or pilots; the need for a common Arctic Coast Guard forum; the creation of an Arctic infrastructure bank; and the development of a funding instrument similar to one used by the International Civil Aviation Organization.

POLICY-RELEVANT CONCLUSIONS INCLUDE: (not in priority order)

- The need continues for meaningful evaluation of response capacity—a tiered approach whereby Arctic nations are able to identify primary, secondary and tertiary response assets. Included in the mix should be consideration of private and/or industry-owned assets, which may be closer.
- Increasing attention should be paid to communications, workforce development, mapping/bathymetry, and navigational aids.
- Differences in systems, geography, and scale of challenge make evaluation of response capacity difficult—there is not a one-size-fits-all approach to infrastructure development.
- Infrastructure development must be responsive to social, environmental and cultural impacts (both positive and negative) as a core element of sustainable development.
- Creative funding strategies (i.e., public-private partnerships) for infrastructure cannot be ignored. Much of the critical infrastructure throughout the North is under the same influences of time, climate change and dwindling resources.
- Investments in infrastructure should be leveraged—an intermodal approach and layering of resources has a multiplier effect on transportation infrastructure development
- Sometimes there are simple solutions to problems that shared information can address; for example, the idea of having information on hand for the Icelandic Coast Guard's point-to-point rotary SAR assets.
- Innovation can originate in the North, where survival is often determined by ingenuity. The Arctic can become the testbed for new technologies and approaches, such as the use of UAV.
- Additional review of loose infrastructure (located outside the Arctic) and mobile assets (vessels that move within the Arctic as well as outside) is warranted.

The workshop served as a useful platform from which technical experts within and between (maritime and aviation) sectors could communicate, share and add value to best practices—an opportunity that should be provided more regularly. At the same time, participants were clear in their call for more data collection and the addition of important layers in future iterations of the AMATII database and map.

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1] CURRENT INFRASTRUCTURE AND RESPONSE

OVERVIEW

To assess the infrastructure that is in place in the Arctic and effectively evaluate the current capacity to support community resupply and resource development activities, as well as respond to emergencies, it is important to recognize that interests go beyond Arctic nations to include many others. AMATII data must be represented accurately but also in a way that is meaningful for mariners and aviators, government officials and private sector interests, in addition to community administrators and northern peoples.

AMATII provides a baseline for marine and aviation infrastructure, although characterizing the capability of each will be an ongoing effort. Further assessment of basic information may be as difficult as it is important for Arctic operations. For example:

- With regard to search and rescue operations, there is a clear need to know where and what kind of fuel exists. The current system reflects a reluctance to share this kind of information, which may be the result of a competitive business environment, security concerns, or fears around security of supply.
- The majority of Arctic nations have fuel caches for emergency response; however, the resource may be owned by different entities (private sector, Coast Guard, etc.) and may include different and sometimes inappropriate fuel types.
- Response capacity is both weather- and distance-dependent. Distance to respond depends on the scale of the response area, which varies widely between Arctic nations.
- Response capacity is very difficult to quantify and may benefit from evaluating reasonable time to respond relative to effectiveness of response. Factors include: 1) time to respond and/or launch an asset; 2) cost to respond; 3) communication/coordination abilities; 4) agility/execution.
- Some nations have a risk calculation for oil spill response to evaluate activity/usage, which might be a useful tool in the future.
- A crucial step to ensuring effective response is training and equipping first responders—human resources are part of the critical infrastructure.
- While military security is not within the purview of the Arctic Council, it certainly affects and drives Arctic traffic and infrastructure needs. Also, it is worthy to note that in the Arctic many facilities that were former military facilities are now public infrastructure.

The AMATII database is a good demonstration of what the Arctic Council is capable of doing both in terms of amassing and vetting data but also in making that information publicly available. It can serve as a valuable access point for reviewing current infrastructure and evaluating response into the future. For it to be a lasting resource there must be a framework for updating and providing feedback through a validation cycle. Future iterations of the project and/or community sourcing of information are options worth considering.

Communication with and between mapping agencies and efforts can help in resolving long-term challenges. Especially important is the need to connect mapping agencies to users. Government can help to build a model for cooperation in which industry may then voluntarily participate, the AMATII database as one example.

Layering of data can help to address some of these challenges, as well as make the information presented more meaningful. For instance,

- There is established agreement on the classification of international airports, on which Arctic nations could build to better reflect local/regional airports, based on such factors as length of runway and refueling capability.
- The International Maritime Organization (IMO) sets the standards for international ports based on security, through the International Ship and Port Facility Security (ISPS) Code. Reviewing this for Arctic use might resolve some of the issues related to classification without prioritizing between locales, providing users a clearer understanding of capacity level.
- Arctic aviation might potentially include the concept of airspace that is served by providers and regions, not just airports and land mass.

Better understanding of trends and drivers results in a clearer understanding of what information is needed to assess infrastructure development. The most robust database requires wide-ranging information. For example, climate change will severely degrade permafrost on which many runways in the Arctic are built. The AMATII database includes a layer to demonstrate permafrost extent in the North.

While the private sector is characterized by competition, it is also possible that increased resource and economic development may drive industry to share information. Public-private partnership in data creation and collection is a new opportunity for the Arctic Council to leverage in order to benefit future iterations of the AMATII database. so that private air and marine infrastructure might be included.

AVIATION

In the aviation sector, the focus is on emergency response infrastructure, followed by resupply and resource development activities, in order of priority. The database can be considered an "on-ramp" to evaluating response, beginning with information about current infrastructure now and additional resources added later. However, there must be a system for regularly updating data and phasing data collection to continue to build on lessons learned. For instance, the current database includes tools that would be helpful for Rescue Coordination Centers (RCCs).

To gain a more comprehensive understanding of multinational assets, a list of resources available in each area should be shared among nations. Future iterations could link the database to standing plans to support a coalition operation with emergency plans, SAR exercises, and review of lessons learned. Additionally, weather cameras allow for evaluation of weather patterns to determine routes. With the increasing use of local web cameras, it would be useful to link the database to a list of cameras publicly available in each nation.

Information needed for fixed wing operations is much different than that required for rotary; i.e., helicopters. Rotary craft operators need the locations of fuel depots while fixed wing operators need runway information and fuel locations. For example, the fuel depots on the east coast of Greenland are crucial for rescue helicopters in order to determine their flight path but because private owners maintain the fuel caches, it is often unknown whether there is fuel available. Adding a layer of data to AMATII that includes Helicopter In-Flight Refueling (HIFR) information would indicate the location and point of contact for these caches and make a significant difference in response time. In Alaska, the U.S. Coast Guard depends on operators to verify similar information in smaller communities. Therefore, shared knowledge of existing fuel supplies is important to effectively evaluate the current capacity for response.

MARITIME

To a large extent, mariners must bring resources with them in order to adequately respond and to be prepared. There is a requirement for European nations to identify ports of refuge, which may need to be further defined for widespread circumpolar use. For much of the Arctic, the term port is a misnomer—a more accurate description would refer to many of these as communities with minimal marine assets.

See table on following page.

ICELANDIC COAST GUARD

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SOME KEY DRIVERS OF ARCTIC MARITIME INFRASTRUCTURE AND CURRENT ASSETS

Alaska (United States)

Drivers identified included offshore oil and gas leasing and development; northern mineral deposits; and rural community resupply via summer barge service.

Key assets identified included the U.S. Coast Guard station in Kodiak; Jayhawk helicopters based in Barrow during the summer; North Slope Borough (municipal) Search and Rescue; Red Dog Mine and the DeLong Mountain Transportation System; Port of Anchorage (85% of goods coming into the state pass through the port); Valdez oil terminal; marine infrastructure at Nome, Kotzebue, Port Clarence; and Dutch Harbor—surface assets for the Coast Guard and a staging area for Shell.

Canada

Drivers identified include exports leaving Churchill and Deception Bay and an increase in small cruise ship travel. Other drivers include both federal and provincial emphases on Northern economic development and scientific research; and the emergence of large/private multinational development enterprises, as well as a transfer of wealth to indigenous groups through treaty resolution. An example of this is the Mary River project on Baffin Island, recently approved by the Nunavut Impact Review Board. All communities have annual cargo delivery.

Key assets identified include infrastructure at Churchill (Manitoba) and Iqaluit (Nunavut); outside of Churchill the majority of communities have very limited to no "port" infrastructure in the traditional sense. Additional assets include the secondary infrastructure of Tuktoyaktuk in Northwest Territories (sheltered but draft limited to 6 meters), Kugluktuk in Nunavut; cross-border support in Nuuk (Greenland) and Dutch Harbor (Alaska/U.S.); seasonal icebreakers (5) support, available within 2-3 day arrival time; and air resources are based in Comox (British Columbia), Trenton (Ontario), Halifax (Nova Scotia), and Edmonton (Alberta).

Faroe Islands

The Faroe Islands are supported by one main port and airport.

Finland

Drivers identified include exports of wood, metal, iron and two refineries; and increasing oil traffic to the Russian Federation in the Gulf of Finland. Potential exists to build rail connections from mines to Arctic ports in Norway.

Key assets are located in Helsinki and Porvoo, where there is SAR staging. Of the 60 ports located in Finland, only 23 are open year-round.

Greenland (Denmark):

Drivers identified include an increasing but small amount of tourism; offshore oil and gas exploration; mining in the south; and development of a new mine outside Nuuk. All traffic is via ship yet there are very few assets along the eastern coast.

Key assets identified include Kangerlussuaq as a main source of air traffic; small communities each with an airport and harbor (for the fishing industry); biggest harbors in Ilulissat and Nuuk; Thule and Narsarsuaq have big airfields; and helicopters operate from inspection vessels.

Iceland

Drivers identified include maritime travel that is possible all year long (ice-free coast); energy intensive industry imports raw materials and exports manufactured goods (Reykjavik as major cargo hub); ferry runs year-round, with 500 passengers weekly from Denmark and Faroe Islands; and Reykjavik has 100 vessel calls in the summer.

Key assets identified include connected road system; Akureyri has a fuel port; Reykjavik SAR; offshore support vessels are based in Reykjavik, but are placed around the country; Ísafjörður and Akureyri have important airfields; small communities along the coast have volunteer rescue teams; the Joint Rescue Coordination Center (JRCC) is both a maritime center and SAR center, with assistance provided by mariners.

Norway

Drivers identified include cruise ship transits south to north; LNG export out of Hammerfest; Barents Sea fisheries; Narvik for export of hard minerals—iron ore from Kiruna, Sweden; and oil and gas exploration/production.

Key assets identified include world class infrastructure along the Norwegian Arctic coast; ports of Kirkenes, Bodø and Tromsø; infrastructure at Svalbard - Longyearbyen; Norwegian Coast Guard icebreaker and offshore patrol vessel *KV Svalbard;* the marine operations for fisheries, oil and gas, cruise ships and container traffic are extensive along the northern Norwegian coast.

Russia

Drivers identified include 50% growth in Northern Sea Route (NSR) traffic and domestic cargo traffic (food, fuel and minerals). Arctic transportation is more prevalent along the NSR than the Northwest Passage.

Key assets identified include the Murmansk Rescue Coordination Center; the Arkhangelsk subsection; ports of Tiksi and Dikson; development of rescue centers.

Sweden

Drivers identified include export and tourism traffic, and winter ice (January to May).

Key assets identified include response, including four big icebreakers, based out of Luleå, and use of Finnish icebreakers; i.e., a common fleet.

2] CURRENT AND FUTURE ACTIVITY

OVERVIEW

Many factors, including tourism and fishing, should be included when considering future activity in the Arctic, but the main driver continues to be resource development. Because of these trends, nations throughout the Arctic are focused on the ability to respond to search and rescue scenarios and environmental incidents. By understanding the infrastructure currently in place and the existing intermodal support networks, it is possible to approach increasing activity in the North from a transportation systems perspective.

It is important to keep in mind that any growth of response capacity will be constrained by limits of the operational seasons and framed by local and regional input — scaling up must be conscious of these fence posts. Additionally, the effects of climate change on infrastructure will not only continue but increase; permafrost changes are of primary concern with regard to infrastructure development. Future projects might review cost/benefit analyses of leveraging between modes of transportation.

AVIATION

Within aviation, main trends include satellite communication, fleet management and community support. The next generation of technology needs to be standardized and shared—including Automatic Dependent Surveillance-Broadcast (ADS-B), air traffic service (ATS) facilities and surveillance coverage. Fleet monitoring and tracking is of utmost importance, aided by the increased use of ground-based transceivers (GBTs).

Currently, however, satellite navigation and communications are difficult north of 70°. The recent announcement of Aireon LLC, a joint venture between NAV CANADA and Iridium for the provision of pole-to-pole satellites with global air traffic surveillance capability set to launch in the next five years, should help alleviate this difficulty. The creation of and adherence to certain standards in the Arctic could assist in developing harmonization and cooperation between nations. Standardization would also provide an opportunity to address the economics of infrastructure development, resulting in economies of scale.

It is clear that there is increasing traffic in the Arctic attributed primarily to civilian travel/cruises and development of natural resources. Cargo traffic between North America and Asia has expanded recently. Mining exploration and surveying, as well as oil and gas development continues across the Arctic. Rising investment in exploration and industry in locations such as Greenland also adds to the number of ships and helicopters.

There is a general expansion of scientific activity to study the changing climate, habitat and impacts, as well as permafrost, sea ice, weather patterns and erosion. Aerial surveillance aids, including through the use of UAVs, in the monitoring of environmental concerns. Of particular interest is the protection of traditional hunting grounds and other areas of significance to indigenous populations.

New fuel types are responding to changes in fuel standards that aim to reduce environmental impact. Other techniques are also being used to mitigate impacts; for example, ADS-B separation standards have changed to increase fuel efficiency and reduce environmental impact.

With increased traffic comes a need for more facilities such as lodging, medical assistance and fuel, as well as increased investment in airports and related services to accommodate steadily growing numbers of tourists. Expanded tourism also suggests a need for more frequent and better-coordinated intermodal connections, such as flights to link cruise ship passengers to ships. In general, the increasing number of flights leads to increased fuel requirements (importation and storage). The environmental impacts of the additional infrastructure and development must also be considered.

Even with infrastructure in place, doubling traffic may correspond to an increased risk of incidents. A growth in air traffic service and a need for accurate information (such as weather information) may increase the need for air traffic control, as well as trained air traffic/information specialists and mechanics—a top to bottom increase in workforce. Additional traffic might necessitate remote access to air information or augmented surveillance. Although new technologies can reduce separation to accommodate more flights, information needs may increase more randomly rather than in the linear fashion of legacy systems like radar. Because the season is shorter, construction cannot react as quickly to changes, leading to a need for the longer window provided by full systems integrated planning.

Responsibility for rescue coordination is not the same as the responsibility for providing assets, however. There is potential

for memoranda of agreement between nations to share assets and build a common approach for the Arctic. Increased coordination of responsibilities would aid in the efficient handling of an event.

Mandatory reporting in the Arctic would be beneficial, as would harmonization of technology between aviation positioning and marine positioning, such as polar standards for equipment, process and procedures. Possible mandatory infrastructure needed for potential emergency landing sites should be considered; investing minimally for diversion capability could prove invaluable in triage should accidents or incursions close runways. With increased activity comes greater risk; the possibility of incident should be a consideration in driving infrastructure investment decisions.

Climate change must also be considered when addressing future aviation infrastructure. There is evidence of permafrost degradation on runway surfaces. It is vital in the Arctic to develop or adapt; new technology for construction and maintenance should be considered. Changing weather patterns have already changed operating models, including snow removal, flight crew training, fleet maintenance and deployment—all which can lead to increased costs. For example, Reykjavik is experiencing less snow and more ice, which requires a change in the infrastructure needed at the airport to handle runway maintenance. Additionally, a changing climate may result in changes in bird migration patterns that can impact aviation; rising sea levels will affect coastal airports.

MARITIME

Most shipping activity in the Arctic continues to be destinational, including an increased interest in transshipment via the Northern Sea Route due to shorter transit times compared to routes using the Suez Canal. Resource development is the main driver of increased Arctic maritime traffic today and for the decades ahead, and continued success in the development of oil and gas would further increase the level of activity. Oil exploration is taking place offshore; gas exploration both onshore and offshore. Involvement of non-Arctic nations and a growing interest in Arctic resources should also be noted.

Growing interest in the Arctic as a tourist destination—including increased cruise ship traffic and adventure tourism via private yachts—has been identified by response agencies as a search and rescue concern. Other trends that merit examination include port ownership, privatization and sharing of rescue assets, and migrating fish stocks. Maritime operating conditions in the Arctic are among the most extreme in the world, and climate change will continue to impact weather, tide and ice conditions.

New IMO emission standards put in place both in emission control areas (ECAs) by 2015 and globally by 2020 will affect shipping routes, technology and infrastructure. The Energy Efficiency Design Index (EEDI) was made mandatory for new ships and may result in a less powerful vessel. These efforts may signal a move toward regulatory standardization across the Arctic as well as growth in cooperation between countries; cooperation that is both stronger and more practical than in the past. Additionally, increased research activities—such as mapping—reflect the unfortunate lack of baseline information in most Arctic research.

With improved technology such as better remote sensing, as well as UAVs and autonomous underwater vehicles (AUVs), shipping has the potential to be more scrutinized. Unfortunately there is a corresponding decrease in experience and human knowledge available. Training and expertise in the pilothouse/ice navigation skills are critical to future arctic marine operations. Future activity in the Arctic should consider—and place a priority upon—an experienced, knowledgeable workforce. Currently there are no common international standards in ice expertise for navigators or pilots.

Arctic strategies and an interface for connectivity exist—in the form of the Council and of such tools as the Sustaining Arctic Observing Network (SAON)—and continue to be leveraged for mutual benefit. Overall, there seems to be a cultural shift toward better planning.

Risk assessment is part of the safety management system currently in place in Arctic nations. Likelihood and impact can be used to determine system risk; maturity of activity or technology establishes who is responsible for risk. Resources required to respond are not terribly different between types of scenarios. Location and marshaling resources depends on collaboration and pre-planning to respond effectively. Surveillance, staging and collaboration are all keys to efficient response.

The Arctic is fairly well monitored in some areas. In Iceland, for example, it began in the 1960s with a 300 nautical mile (NM) radius of long-range identification and tracking (LRIT), with vessels required to carry Automatic Identification System (AIS) or emit an hourly message. Reporting in Canada is mandatory for all vessels of 300 gross tonnage or more, and vessels carrying pollutants or dangerous goods. In Sweden, the Baltic is covered. Finland has a comprehensive service

and camera network as well as mandatory cargo reporting in the Gulf of Finland. Norway also has a comprehensive system with advanced monitoring, but Svalbard is beyond Norwegian coverage.

The U.S. and Canadian Coast Guards have focused on ships to maintain Arctic security. For instance, the USCG has established a mobile command center and seasonal presence in Barrow, Alaska. It was suggested that better synergy and coordination might be possible through something like an Arctic Coast Guard Forum, under or outside of the Arctic Council, depending on the preference of Arctic states.

New and potential activity in each of the eight Arctic nations includes: feasibility study conducted on an Arctic deep-draft port (Alaska/U.S.); indigenous training/workforce development (Alaska/U.S. and Canada); new or developing Arctic policy/strategy (Alaska/U.S., Finland, Sweden, Iceland); offshore development (Greenland/Denmark, Alaska/U.S., Iceland, Norway, Russia); and opening to international traffic/NSR Law (Russia).

GEOFF COOPER

3] INFRASTRUCTURE AND INVESTMENT

OVERVIEW

The economics of resource development suggest an intermodal approach to infrastructure investment, with connectivity and the ability to export resources as well as to support operations. However, this approach must incorporate positive impacts to community development and sensitivity toward maintaining cultural traditions (managing growth for preservation as well as increased connectivity to allow access to resources). In Finland, for example, governance of transportation once separated systems. Recently, a more comprehensive approach has been taken to examine the entire chain of transportation infrastructure to assess economic costs and value.

Infrastructure development may need to be clarified in terms of operational versus aspirational in order to encompass critical infrastructure needs for current systems, planned infrastructure to support future needs, and growth scenarios sensitive to feedback from local communities.

One suggestion for cross-border economic development was the formation of an Arctic infrastructure bank, of which there are myriad regional/geographic examples currently in the international sphere. Sustainable development from this perspective might rest on the long-term returns of those investments. However, it is important to differentiate between the financial decisions made by an infrastructure bank and the policies of a government. Generally, there must be agreement on the roles of participants and the establishment of shared aims.

A follow-on to this idea was an Arctic economic zone that might feature an Arctic bank or Arctic investment corporation, where combined funding streams/interests create a "Special Economic Zone." Something like this could provide useful cross-border incentives for Arctic Council nations, though certainly not applicable for every situation. The Northern Sea Route, for instance, may not look for international investments. However, the global commodities market and global financial mechanisms should not be underestimated in their ability to influence decision-making—positively or negatively—on investment choices.

AVIATION

While there are differences across the Arctic, the primary question—how to fund aviation systems in the Arctic—may be answered by exploring similarities between northern European systems. The hub-and-spoke model helps to consolidate areas so that regions can make systems choices. The largest airports in each country act as an anchor for the rest of the system, often subsidizing smaller airport operations. Infrastructure development, air navigation use and charge processes vary greatly by country, impacting private sector decision-making. Using a systems approach combined with a social compact, the bulk of revenue comes through larger airports.

This differs from non-European Arctic nations. In the U.S., federal government grants allow for airport development; in Northern Canada, it is largely the territorial governments who fund airports, with some federal support for capital projects; and in Russia, airports/heliports are operated by the federal government.

Airport infrastructure is already increasing in response to resource development in much of the Arctic. The balance struck between private and public sector infrastructure investment continues to be a thorny challenge. New infrastructure may be hampered by a lack of public sector funding, requiring support from the private sector in collaboration with communities, and thereby tying resource development and community development together. With this in mind, there should be coordination between local, sub-national and federal governments, as well as private entities interested in development.

International agreements—for example, through the International Civil Aviation Organization (ICAO)—are in place for operation and funding of air navigation services across borders. Although not yet extended to airport facilities, perhaps a special case might be made for Arctic infrastructure: each passenger who crosses the North Atlantic might pay a special fee to the fund. A similar ICAO instrument has the potential to be created for polar regions to fund SAR and emergency response assets. Without this type of cost-sharing, the up-front capital costs of establishing infrastructure are prohibitive.

See table on following page.

WHERE DOES THE MONEY COME FROM TO FUND AVIATION INFRASTRUCTURE?

Alaska (United States)

The Federal Aviation Administration (FAA) administers the Airport Improvement Program (AIP) funding—federal dollars from a trust fund acquired from surcharges on every airline passenger in the United States. Alaska receives $200 million per year (for 10 years) but the grant program reflects federal priorities: rural airports (most communities are only accessible by air), safety projects for certificated airports (jet service), rehabilitation programs (pavement), and to big international airports for recapitalization. Future trends indicate that federal funding is shrinking steadily. In an era of diminishing federal budgets for many nations, how to prioritize projects receives increased importance. In Alaska, for example, a bottom-up approach causes airports to compete for what is needed. Here, a strategic approach to building infrastructure would have a lot of benefit.

Canada

With a limited road system, much of northern Canada is only accessible by air, including all of Nunavut's 25 communities. Airports in northern Canada are owned and operated by provincial or territorial governments. As part of the devolution of smaller airports to local authorities and the territorial governments, the federal government created an Airports Capital Assistance Program (ACAP) to help with essential, safety-related infrastructure projects. Federal ACAP funding is available to airports that offer year-round regularly scheduled commercial passenger service and have at least 1,000 year-round regularly scheduled commercial passengers. In the case of the three territories (Yukon, Northwest Territories and Nunavut) Transport Canada transferred the airports with long-term funding agreements. NAV CANADA is responsible for providing Air Navigation Services (aircraft flight management), while airports provide airside/groundside infrastructure.

Finland

Helsinki is the main revenue airport; others are subsidized.

Greenland (Denmark)

As there are no roads, Greenland is solely dependent on air travel. Only two airports are self-sufficiently funded. The Greenland Airport Authority (GAA) is home-rule owned, backstopped by the Government of Denmark. Ownership has been shifting in recent years, pushing the economic burden on GAA, including responsibility for a number of remote airports. There is a moral obligation to maintain even those airports that are not self-sufficient.

Iceland

Iceland follows a European system regarding airport infrastructure and flight operations of airlines. In remote areas, certification is necessary for both infrastructure and operations. Public Service Obligation's purpose is to provide air transportation to remote areas and to ensure the socio-economic benefits. In Iceland, every three years new contracts for service to remote locations go to the lowest bidder. Infrastructure is handled separately, with public tenders for each project. Aviation provides 9,200 jobs in Iceland; 2.5 million passengers travel through Iceland's international airports—indicators of the importance of the aviation cluster. Domestic airports are partially funded through user fees, supplemented by the government.

Norway

Avinor AS (a state-owned, limited company) owns nearly all the airports in the country, with nearly half funded by user fees; the others receive funding from commercial ventures, such as parking and duty-free shopping at airports. Only five of 46 airports have positive revenue, and they pay for all the rest. Avinor pays a dividend but receives no funding from the owner. Avinor has a contract with each airport until 2015; then there will be a performance review of the largest to determine risk-sharing. Norway also has a social responsibility like Iceland—a duty to keep airports running despite unprofitability. The goal is to cut costs as much as possible, yet any expansion must be financed wholly by Avinor.

Russia

The government is reviewing airport infrastructure and support. Most general aviation airports for fixed wing aircraft became helipads without government subsidization; i.e., the airports were purchased by private companies for helicopters. The federal government subsidizes state-owned companies and works to find economical ways to manage airports. As one example of private enterprise, Vertical-T Air Company is working with Alaska operator Ryan Air to bridge the gaps between Chukotka, Kamchatka and Alaska with smaller aircraft. In addition, Yakutia Airlines provides weekly seasonal service from Anchorage, Alaska to the Kamchatka Peninsula.

Sweden

The critical airports are owned by a state-owned company. Similar to Norway in funding, the aviation systems are owned by a different entity. There are no governmental subsidies; in fact, airports must pay returns to the government.

In general, aviation infrastructure in the Arctic is funded differently than air traffic services. Funding is decreasing overall, yet the need for infrastructure is increasing. Possible solutions include:

- Companies coming in from outside can provide key assistance, giving self-sufficient infrastructure time to develop. For instance, the state may finance/build but require community payback; i.e., it is not a private airport for private interests. Joint funding between interested parties and governments may be a viable solution.
- Perhaps sovereign wealth funds like those in Norway, Europe and Alaska can play a role in providing the initial capital to build SAR capacity.
- Government is responsible, to a large extent, for SAR and SAR infrastructure. Yet industry will have an increasing role in contributing to the development of response infrastructure.

MARITIME

Public-private partnerships (PPPs) should be considered to address infrastructure development, including mobile assets such as icebreakers. Rather than relying exclusively on public funding, Arctic states can draw in industry or private sector resources to bridge infrastructure investments, possibly through mechanisms such as an Arctic bank or infrastructure fund. Using the legal, regulatory and fiscal mechanisms that states, municipalities and industry can bring to bear is an important frame of reference. Collaborative investment, coupled with responsible resource development, results in forward thinking approaches to the impact of a project's development. This reflects a nation's priorities—how money is spent, rather than how much—and ties into sustainable development.

It is critical to note that investments are always more risky in the Arctic because costs will always be higher, so development may not occur in the Arctic unless the desired resource is unique or until technology makes extraction economically viable. Government can help to offset the risk while its peoples benefit in the exchange. The question is less about finding sources of funding and more about creating an atmosphere that fosters good investments. Funding will need to come from the private sector, but risk needs to be shared. Also, industry is willing to wait for the right opportunity and will not make risky investments.

Investment in Arctic transportation infrastructure centers on four "goods"—vessels, harbors/ports, workforce, and communications/navigational aids. Broadly speaking, northern nations are looking at oil spill research, resource development strategies, and workforce development and mobility.

There are approximately 100 icebreakers in the world, with an average age of 20-30 years. A new mid-sized icebreaker (Ice Class 10) has a current pricetag of 100-150 million Euros. Individual nations are pursuing a variety of. Canada is exploring investment options for an additional polar icebreaker. Iceland is looking at investments in rescue helicopters. Greenland (Denmark) is focused on maintaining current infrastructure. Sweden is replacing older icebreakers (5-10 years), which are used exclusively in the winter, so private partnerships make much sense; and Norway is considering adding another icebreaking patrol ship (like the *FV Svalbard*) to respond to increased development in the Barents Sea. Russia has a state program of Arctic fleet renovation (2020) and they have started construction of 5 medium icebreakers and 1 large icebreaker. In Alaska/U.S., the U.S. Coast Guard (USCG) has been investing in new National Security Cutters.

In addition to the icebreakers and four "goods" mentioned above, other areas for infrastructure investment vary from nation to nation, among them: Canada—community harbor facilities, a fueling station in Nanisivik on Baffin Island, and a Canadian Forces training facility in Resolute Bay; Iceland—harbors and airports on east coast; Russia—Rescue center implementation program (30 million Euros); Alaska/U.S.—feasibility study of Arctic port and public private partnerships for Port Clarence, as well as infrastructure upgrades in Nome, Kotzebue, Anchorage and Point Thomson.

Vessel tracking capabilities, communications and navigational aids are of primary concern in many Arctic states. Some of these issues are being handled by private (e.g., Shell) and independent (e.g., Marine Exchange of Alaska) sector interests. However, these are pan-Arctic investments.

The other big area for investment, albeit with a different rate of return, is workforce development and training. Standardization in this arena would be beneficial, to include ice navigation and common training requirements for mariners/crew.

4] INFRASTRUCTURE AND SUSTAINABLE DEVELOPMENT

Arctic nations should work to better understand the impact of transportation infrastructure on sustainable development, leveraging growth, change and increased activity in this pursuit. States can consider the impact of infrastructure on social and economic development; cross-border collaborative opportunities; environmental and cultural considerations; and a better way to evaluate the risk-reward process. Given the six priorities of sustainable development identified by the Arctic Council, it is quite clear that transportation and response infrastructure are closely tied to this theme.

Already identified is the impact of climate change and its effect on sustainability; e.g., costs to runway infrastructure. Another way to think of responding to change is survivability—the application of internal and external resources to support the future of the peoples of the North. Issues are not short-term in this regard, and require the careful planning inherent to a strategic approach in the Arctic.

One area of concern is the role of external (outside the Arctic) financing and impact of non-Arctic states on investment decisions. This is not a straightforward question and should be weighed carefully in future considerations. Outside investment is a sensitive issue for many who prefer self-reliance or partners of choice, while many recognize the economic benefits of something like foreign tourism.

With regard to workforce development, rural areas in the Arctic benefit from community-based deployment—hiring peoples of northern communities rather than importing workers. In Iceland, in order to provide greater awareness of job opportunities, the Icelandic Coast Guard (ICG) used to bring youth onto ships regularly. In another example, the Nunavut (Canada) Training Consortium, in conjunction with the Marine Institute, is providing training opportunities within Nunavut out of their campus and through outreach to Nunavut communities. Private sector companies (PetroNav, Baffinland Fisheries Consortium as examples) also provide training to Nunavut citizens.

Infrastructure can also facilitate community-building. For example, Svalbard was once only populated by male hunters and miners, but expanded air links allowed access by women and children. Permanent Participants, however, should be given elevated consideration in this and in training as marine mammal and weather observers.

The use of technology—like implementing satellite-based tools, such as ADS-B—limits environmental impact. Initial estimates of benefits from the Aireon[SM] satellite surveillance service indicate emissions reductions of 35 million metric tons and fuel savings of $6-8 billion from 2017 - 2030. At the same time, universities have the capacity to offer distance learning (e.g., the asset of broadband opens horizons of education and employment). Traditional indigenous knowledge should be incorporated into the decision-making process around needs, development and location of Arctic infrastructure.

Right-sizing infrastructure is also a key factor in sustainable development—for example, Arctic nations could improve sewage and water treatment facilities relative to runway lengths. Infrastructure stimulates the growth of businesses and services, not to mention providing jobs, supplies, export power, fuel, tourism, sea rescue, medical facilities, and education. The possibility is increasing of leveraging larger port facilities (e.g., developing an International High North rescue center in Reykjanes), which provide new educational and employment capabilities, and could support specialized operations such as search and rescue.

In the future, response capacity and sustainable development will be more clearly linked. This may be seen in terms of leveraging assets—utilizing equipment to take advantage of availability, improving communication with local communities (e.g., tourism), educating ship passengers by using local knowledge, and improving safety regimes (e.g., hours of rest for mariners).

In developing infrastructure, a cost-benefit analysis is useful to avoid stovepipe effects, and should include a socio-economic index tied to funding; e.g., incentives to industry that works with local community.

One element of consideration is the question of rural-urban access and the ability of rural residents to reach essential services within an acceptable amount of time. In Iceland, planning ensures that any person can reach services in Reykjavik within 3-1/2 hours by road or air. In order to make that happen in far-reaching communities, airlines compete for a three-year subsidized contract to provide the service. EMT services supplied by the ICG determined the airstrips needed; if an airport is deemed important, the local community has to ensure year-round 24/7 accessibility. This is handled differently in all Arctic nations.

Tourism is another area that directly impacts sustainable development, with different approaches by Arctic nations. Russia, for instance, uses some of its icebreakers to take tourists to the North Pole from Murmansk, and needs additional infrastructure and security to accommodate tourist ships. Iceland recognizes the balance that needs to be struck between increasing tourism and maintaining the pristine environment that drives that tourism.

5] CONCLUSIONS: WHAT'S NEXT?

FUTURE OF THE DATABASE

There are a number of key databases under development by the Arctic states and others. As an ongoing effort, AMATII will collaborate and work to avoid duplication with these other processes. Already, there have been discussions to layer AMATII data over the Arctic SDI mapping being done collaboratively by the eight Arctic nations' mapping agencies. Arctic Portal has been a good partner throughout, providing a valuable platform from which to integrate future layers.

Data that would be useful in future iterations of AMATII:

AVIATION
Runways and surfaces
Local readiness
Accurate mapping
Proximity of medical facilities
Creation of an Airport Remoteness Index
Perennial weather conditions
Classifications via runway sizes, fuel supplies
Language
Buildings with power and heat
Weather forecasting capability
Responders—assets and times
Support capabilities at airport
Post incident capabilities for salvage

MARITIME
Vessel traffic (pilotage)
Access to icebreakers
Fees and regulations that affect use
Language
Hazmat cargo (risk analysis)
Passengers by country of origin
Availability of salvage vessels
Seasonality
Buildings with power and heat
Weather forecasting capability
Responders—assets and times
Support capabilities at airport
Post incident capabilities for salvage

ADDITIONAL LAYERS TO DEVELOP
Aeronautical Information Publication (AIPs) linked directly to the airports
Ground services—cranes, lifters, etc.
Weather data
Communications
Exercise plans
Navigational aids
Asset capabilities
Medical facilities and capabilities
Fuel type and storage; e.g., Helicopter In Flight Refueling (HIFR) information
Weather forecasting capability
Responders—assets and times
Support capabilities at airport
Post incident capabilities for salvage
Command and control centers (incident command systems)
First responder centers
Location of Rescue Coordination Centers (RCCs)
Connectivity to other modes of transportation
Resupply cycle
Icebreaker operating areas
Regular flights for passengers
Access via alternative (ice, logging, haul) roads
Economic development and social activities nearby
Primary government contact

Future iterations could address the "what ifs," such as diversion points (often to single runways or places of refuge)—worst case scenarios are difficult to plan for and planning needs to be done in stages. Traditional knowledge should be actively incorporated into infrastructure development and the communities consulted in planning for response capacity. The AMATII database could include risk management strategies, recognizing the fluidity of risk management, and consider proactive collaborative risk analysis with regular review for the future.

Finally, recognizing that the Arctic is not a static environment, future work could identify infrastructure that is under risk and needs remediation. In response, AMATII could include layers of information that affect infrastructure, like permafrost mapping or changed weather patterns such as ice storms.

Appendices

A. Arctic vignettes—innovative best practices
B. Case studies—showcasing Arctic infrastructure
C. Workshop materials
    1) Workshop agenda
    2) Workshop participants
    3) Project-related terminology
    4) List of data points and definitions
    5) List of Arctic marine and aviation infrastructure

APPENDIX A: ARCTIC VIGNETTES—INNOVATIVE BEST PRACTICES

Title of project:

Alaska Emergency Towing Systems

UNITED STATES / ALASKA

LOCATION OF EFFORTS:

Since the program's origin, it has expanded statewide. The Alaska Department of Environmental Conservation (ADEC) has purchased and stored 10-inch Emergency Towing Systems (ETS) at the United States Coast Guard (USCG) Air Stations in Kodiak and Sitka, the Navy Supervisor of Salvage warehouse at Fort Richardson, the Emergency Response warehouse in Adak, and at the Dutch Harbor Airport. A 7-inch system is positioned at the USCG Air Facility at Cold Bay, Alaska. The City of Unalaska also maintains a 7-inch system at the airport.

PRIMARY PURPOSE OF THE INITIATIVE:

An ETS is a pre-staged package of equipment that may be deployed in the event a disabled vessel requires towing assistance. A manual and DVD that instructs responders on the operations of the system as well as procedures for deployment accompanies the system. The system is designed to use vessels of opportunity to assist disabled vessels that are in Alaskan waters. It consists of a lightweight high performance towline, a messenger line used in deploying the towline, a lighted buoy, and chafing gear. These components may be configured to deploy to a disabled ship from the stern of a tugboat or airdropped to the ship's deck via helicopter.

WHY WAS THIS UNDERTAKEN?

The ETS program came into existence following the near grounding of the *M/V Salica Frigo* on March 9, 2007 in Unalaska Bay. The Mayor of Unalaska convened a meeting to address the possibility of future groundings and to discuss local emergency response solutions. This initial meeting prompted the ETS workgroup whose goal was to develop emergency towing capabilities for disabled vessels in the Aleutian Subarea using locally available tugboats in conjunction with ETS equipment stationed in Unalaska. Additional information on the Alaska Emergency Towing systems can be found at: http://dec.alaska.gov/spar/perp/ets/index.htm

WHAT ARE SOME OF THE VALUE ADDED RESULTS?

The project has continued over the past 5 years with a mobilization and deployment exercise conducted annually in Unalaska. In December of 2010 the ETS system was deployed from Unalaska in an emergency situation to assist the disable cargo vessel *Golden Seas*. This equipment, along with the availability of an appropriate sized towing vessel helped avert a possible grounding.

WHAT WERE SOME OF THE FACILITATIVE FACTORS (E.G., GOVERNMENT AND PRIVATE SECTOR FUNDING, DECISION-MAKING)?

The majority of the funding to purchase and maintain the ETS's has come from within the ADEC's Spill Prevention and Response Division. ADEC did receive a grant through the Alaska Coastal Impact Assistance Program (CIAP) for the purchase of two large systems that are currently staged at USCG Air Station Sitka, and at the Navy Supervisor of Salvage facility at Joint Base Elmendorf Richardson. Funding was also provided by the Aleutian Islands Risk Assessment, which provided funding to purchase a 7-inch system for USCG Air Facility in Cold Bay. This will help facilitate a quicker response for the Unimak Pass area, which is a high transit area use by ships following the great circle route.

The majority of the support provided by the marine transport industry has been by providing their vessels, crew and fuel to help conduct the training exercises. Upon completion of the exercises all lessoned learned are vetted through the primary workgroup members (ADEC, City of Unalaska, USCG, Alaska Marine Pilots, Dunlop Towing).

WHAT TECHNOLOGY WAS USED? WHAT IS STILL NEEDED?

The Emergency Tow Systems are complete rope assemblies consisting of a Plasma® Tow Line with thimbled eyes, Spectra floating pickup line and lighted buoy in a weather proof plastic container. All components are in full compliance with the International Convention for the Safety of Life at Sea (SOLAS) requirements and each tow line is supplied with a certified test report. To facilitate air transport the towing system is packed within a cargo net within the storage container. ADEC has been in recent communication with the City of Nome and they are very interested in staging a small ETS in their community. ADEC is in the process purchasing a large ETS for Ketchikan and the smaller ETS for Nome.

Additional tugs with sufficient horsepower and proper configuration need to be available for timely responses. The State of Alaska was fortunate to have the tug *Tor Viking* in Dutch Harbor when the *M/V Golden Seas* encountered problems.

HOW DOES THIS FIT INTO THE BIGGER PICTURE/SYSTEM?

Emergency Towing Systems are but one way to reduce the risks associated with marine transportation in Alaska. The problem is particularly acute in the Aleutian Islands where foreign flag vessels travel the great circle route in innocent passage. When groundings and spills occur in this region, they are often in remote areas where spill response is challenging. Additional information on risk reduction measures being considered can be found at the Aleutian Island Risk Assessment web page at: http://www.aleutiansriskassessment.com/

WHAT IS THE IMPACT ON SUSTAINABILITY?

To maintain SOLAS compliance, ADEC inspects each system annually. Travel is the largest part of our cost with the State being so large. Normally the Coast Guard or the community will provide one staff member to assist with the inspection and repacking. Funding in the near future does not appear to be a problem.

Title of project:

Aviation Weather Observation System (AWOS) Installation, Wekweètì, Northwest Territories, Canada

CANADA

LOCATION OF EFFORTS:

Wekweètì Airport, Northwest Territories, Canada

PRIMARY PURPOSE OF THE INITIATIVE:

To provide essential aviation weather to pilots in an area where none had previously existed.

WHY WAS THIS UNDERTAKEN?

The Wekweèti community is isolated and dependent on air transportation when the winter road is not available. Air travel is essential for personal and business purposes, as well as for timely access to medical services. However with no altimeter to facilitate IFR approaches, air transportation was only possible in VFR flying conditions.

Without weather observations (METAR/SPECI) no aerodrome forecast (TAF) was produced. Aircraft operators could only use graphical area forecasts (GFA) for flight planning. This created operator scheduling and dispatch issues, including increased fuel load requirements, cancelled flights and reductions in cargo or passenger capacity.

Changes to passenger weight calculations in 2005 further reduced capacity and revenue potential. Additionally, a requested RNAV/GNSS instrument approach was not possible without an altimeter source.

In addition to scheduled charter and MEDEVAC flights, there is considerable aviation activity in the area related to resource exploration and tourism. Aircraft operators cited lack of weather information and IFR approaches as impacting their ability to provide service and control operating costs.

WHAT ARE SOME OF THE VALUE ADDED RESULTS?

AWOS installation offered the following benefits:

- 24/7 altimeter and weather observations with real-time weather radio broadcast and weather camera imagery.
- Enabled instrument approaches (RNAV (GNSS)) at Wekweètì to be published, improving air service reliability 24/7.
- Enabled the introduction of an official weather observation program and for TAFs to be issued for the airport, which is now an IFR alternate for nearby communities.
- Offered opportunities for reduced operating costs for aircraft operators (reduced fuel load).
- Improved safety by giving pilots and dispatchers up-to-date weather and forecast information for better flight planning.
- AWOS data improved the quality of the TAF for Yellowknife, Diavik and GFA.
- Environment Canada public weather information, forecasts, and climate data are now available.

WHAT WERE SOME OF THE FACILITATIVE FACTORS (E.G., GOVERNMENT AND/OR PRIVATE SECTOR FUNDING, DECISION MAKING)?

The NAV CANADA Level of Service (LOS) team conducted an aeronautical study in consultation with:

- local, territorial and federal governments,
- commercial aviation providers,
- public and private aviators, and
- the general public.

A project was subsequently approved to install an AWOS at Wekweètì.

WHAT TECHNOLOGY WAS USED? WHAT IS STILL NEEDED?

A NAV CANADA AWOS includes automated meteorological sensors for measuring:

- wind speed and direction,
- pressure,
- temperature and relative humidity,
- ice accretion,
- sky condition and ceiling,
- present weather, and
- precipitation accumulation.

All this information, including images from aviation weather cameras is sent via satellite to the NAV CANADA central processing servers in Ottawa. The information is made available on the NAV CANADA Aviation Weather Web Site (AWWS) and through external agencies such as Environment Canada. No further technology is needed in order to determine the aviation weather conditions.

HOW DOES THIS FIT INTO THE BIGGER PICTURE/SYSTEM?

More weather stations within northern airspace allows for more accurate weather forecasts and modelling, improving the ability of operators to plan for, and to provide safe and reliable service.

In addition, airports that can provide essential aviation weather information can be designated as suitable IFR alternate airports, thus reducing delays or flight cancellations while pilots and dispatchers wait for VFR conditions.

WHAT IS THE IMPACT ON SUSTAINABILITY?

NAV CANADA initiatives plays a key role in helping to improve safety and service and pave the way for future efficiency gains, including customer cost savings and reductions in greenhouse gas emissions.

The installation of the AWOS at Wekweèti contributes to sustainability by allowing the community to be designated as an IFR alternate. This designation and additional weather information helps pilots to plan more efficient routes, and use less fuel. In addition, improved aviation access to the region spurs sustainable growth in the area, with better opportunities for business, resource and tourism development.

Title of project:

Norway and Avinor

NORWAY

The state-owned limited company Avinor was established in 2003. It is currently responsible for the operation of 46 of the 52 civil airports in Norway. Avinor operates small local, medium regional and large hub airports. The biggest airport is Oslo airport with 22 million passengers. The company is also responsible for the entire air navigation system in Norway, both for civil and military sector.

Airport density is very high in Norway and aviation is very important due to topography, long distances, sparse population and Norway's location at the outskirts of Europe. Air transport is especially important for the peripheral regions and the northern part of Norway where alternatives are weak. This is a necessity for industries like oil and gas, tourism and the health sector in addition to general public.

Due to demanding climate Avinor is at the forefront of research into areas like winter operations, tough weather, operations on small airports, satellite navigation, environmental development and climate adaptation. It is conducting research into a number of areas in order to cope with ever more challenging environment.

The arctic region is of national importance to Norway and Avinor is a major instrument in developing safe and sustainable growth in the region.

SOME EXAMPLES OF IMPORTANT PROJECTS:

SCAT-I

Based on two major accidents early in the 1990s the Norwegian National Assembly decided in 1996 that vertical guidance was to be implemented at the local short runway airports. Conventional ILS Glide Path was considered too costly and technically challenging due to terrain. As an alternative the SCAT-I development project was established. SCAT-I is the world's first GPS-based precision approach system.

The first SCAT-I was put in operational use in 2007 and the project will be completed in 2013 when implemented on 17 local airports in total. The system will remain in operation until 2025.

HAMMERFEST

The current airport in Hammerfest is served by Dash 8 aircraft. The runway is only 800 meters long, and expansion is not possible. Punctuality figures are not satisfactory. Forecasts show a strong increase in passenger traffic, from 106,000 passengers today, to 150,000–190,000 in the year 2025. This is due to heavy offshore investments in the oil and gas industry. There is a strong local demand for a new site where larger aircraft can operate. Avinor is currently carrying out a feasibility study. Hilly terrain and rough climate with strong winds and frequent fog have made it difficult to find a suitable site. A report describing the various alternatives is recently presented, but Avinor has not yet reached a final conclusion.

SVALBARD—THE NORTHERNMOST AIRPORT IN THE WORLD

The aerodrome opened for traffic in 1975 and is approved for CAT I operations. It may not be used by ACFT with higher code letter than D without permission from the Norwegian CAA. All traffic to, from or within Svalbard is subject to prior permission due to Svalbard environmental protection law. The airport has daily scheduled flights to and from mainland Norway and air traffic service (AFIS) is provided 24/7, with approximately 130,000 passengers and 6,700 movements per year.

APPENDIX B: CASE STUDIES—SHOWCASING ARCTIC INFRASTRUCTURE

CASE STUDY: CANADA | PORT OF CHURCHILL

The Port of Churchill is located in the west coast of the Hudson Bay in Manitoba, Canada, and its unique location gives it access to the vast resources of Western Canada and Central United States and closer connections to the Arctic communities in Nunavut. Manitoba has been known as the hub of transportation between eastern, western and northern Canada. Manitoba is also centrally located in the continent centering between Montreal, Vancouver, Mexico City and Nunavut. This is why Manitoba is involved in the development of the Mid-Continent Trade Corridor, which links Manitoba to eleven U.S. states. Major exports include grain, manufactured goods, and mining and forest products. Imports include ore, minerals, steel, building materials, fertilizers, and petroleum products that is then distributed to central and western Canada and the United States.

The infrastructure of the port was constructed in the 1930's mostly for the export of grain and the import of industrial goods. Additionally, the port served the northern industrial and community development, Canada's strategic requirements for defense and sovereignty, and the supply of Canada's Arctic communities. In 1997, OmniTRAX, Inc. purchased the Port of Churchill from the Government of Canada and the port is now operated by the Hudson Bay Port Company. Today, 90% of the traffic comes from grain exports and the remaining 10% from resupply of communities in Nunavut and minimal amounts of peas and canola. The first-ever shipment from Russia arrived in 1997.

Currently, the port operates 3,000, 1,600 and 600 horsepower tugs and has a maximum depth of 11.5 meters. The Hudson Bay Railway also connects the Port of Churchill to the Canadian National Railway System.

CASE STUDY: CANADA | IQALUIT AIRPORT

The Iqaluit Airport is located on Baffin Island in Nunavut, Canada 1,977 kilometers north of Ottawa. The US Government originally developed it as Crystal II and then later Frobisher Bay Air Base during WWII as a staging ground. The base also played a vital role during the Cold War. It was used by Strategic Air Command to support Project Nanook, which was a mission to map the Arctic and develop navigation routes. In 1963, the Air Force Base was closed and the airport became a commercial airport. Since the 1950s, civilians have been using the airport as a stop for planes transiting the North Atlantic.

Because Nunavut has many small communities that are not connected to any road system and ports are rare, air transportation is the dominant mode of transportation. Iqaluit, because of its size and location, is the staging ground for Nunavut, and as populations are growing in Nunavut, there is a need for a bigger airport. The Government of Nunavut is planning a large overhaul of the airport that is expected to cost between $250-$300 million (CAD). This project will be a public-private partnership with the Government of Nunavut paying for half of the project, by borrowing money, and a series of private enterprises paying for the other half. The expansion to the airport includes an additional taxiway and apron so that multiple jets can operate at the airport. The expansion will also include a new terminal, bigger parking lot, and repaving the 2700-meter runway. Currently, First Air and Canadian North have been operating at the airport, and now Air Greenland is also operating weekly flights to Nuuk.

This is the first public-private partnership that has been done in Nunavut, but the rest of Canada has used this model well. The three teams that have been shortlisted for further consideration are Arctic Infrastructure Partners, Plenary Group and Edmonton Airports Group, and Mittarvik Development Partners. The private partnership will operate the airport for the next 30 years. The federal government also announced that it would be giving $77.3 million (CAD) to the project because they believe the project will provide significant job creation, training and economic development. Construction is expected to start in 2014 and be completed by 2017.

CASE STUDY: FINLAND | PORT OF HELSINKI

Helsinki is Finland's main port, specializing in unitized cargo services for Finnish companies engaged in foreign trade. The Port of Helsinki has frequent regular line traffic, balanced import and export. It specializes in unitized cargo traffic, containers, trucks and trailers. The Port of Helsinki provides a general setting, and successful cooperation makes the Port of Helsinki efficient, effective and sound.

The Port of Helsinki contributes to the business life and prosperity of Helsinki in a number of ways. As an active developer of the business environment, the Port of Helsinki establishes the framework and coordinates the operations of the port. As Finland's busiest passenger port, there are connections to Stockholm, Tallinn, Travemünde, Rostock, Gdynia and St. Petersburg. At the height of the summer season, there are 17 departures to Tallinn daily. During summer time international cruise ships make almost 300 visits and bring over 360,000 tourists to Helsinki.

The value of the cargo traffic at the Port of Helsinki represents approximately one third of the value of the entire Finnish foreign trade and two-fifths of the Finnish foreign trade transported by sea. Cargo traffic at the Port of Helsinki consists mainly of Finnish foreign trade imports and exports. The core of the cargo traffic consists of goods transported in containers, trailer trucks, trailers and similar units.

The liner traffic network of the Port of Helsinki is the most extensive and versatile in Finland. There are frequent, regularly scheduled connections from Helsinki to ports on the Baltic Sea, the North Sea and the Atlantic.

There are about 130 weekly liner traffic departures from Helsinki. Substantially more destinations are connected on a weekly basis, as many of the vessels visit several ports en route. There are almost 90 weekly departures by ships transporting goods to Tallinn alone.

CASE STUDY: FINLAND | HELSINKI VANTAA AIRPORT

Helsinki Airport is the leading long-haul airport in Northern Europe and a popular transfer point. The airport's strength is its location along the most direct and quickest route between Europe and Asia.

Helsinki Airport has been chosen as one of Europe's and even the world's best airports from the year 1997 onwards. The airport offers 130 non-stop destinations around the world and 350 departures a day, connecting Europe with the rest of the world. About 90% of Finland's international air traffic passes through Helsinki Airport. It is the principal airport in the network of 25 airports operated by Finavia, the Finnish Airport Operator. Finnish airport administration Finavia Corporation supports Helsinki Airport in its co-operation with Plan Finland, a development co-operation organisation.

Basic facts:

- Passengers: 14.9 million (2011)
- Landings: 95,312 (2011)
- Runways: 3
- Terminals: 2
- Airlines: 33
- Employees: 20,000
- Companies: 1,500

The airport's three runways provide a platform for future growth while the airport can accommodate extra-wide aircraft such as the Airbus A340 and Airbus A350, the former already in service and the latter being scheduled to enter service at Helsinki Airport with Finnair in the coming decade. The airport is the international and domestic hub for Finnair, the Finnish flag carrier. It is also the hub for Blue1, the Finnish regional division of SAS. Low cost carrier Norwegian Air Shuttle and Flybe Nordic are based at Helsinki Airport as well. The use of three runways allows for efficient clearing away of snow and ice during the winter months to keep the airport open

CASE STUDY: FAROE ISLANDS | VAGAR AIRPORT

Vagar Airport, located near Sørvágur, is the only airport in the Faroe Islands. The airport was originally built as military base during WWII. Closed after the war, it reopened in the early 1960s as a civilian airport with Air Iceland and Atlantic Airways offering flights to destinations like Reykjavik, Bergen, Billund, London, Oslo and Copenhagen. Atlantic Airways Helicopters also offers service to some of the smaller islands in the area. In 2011, there were approximately 200,000 passengers, with the peak coming in the summer months of June, July and August. Eighty-five percent of those passengers came from Denmark, with another 7% from Iceland mostly for shopping, holidays, sports and culture.

From 1963 to 2007, the Danish Civil Aviation Administration administered the airport, but now the airport is controlled by the Faroese control. The airport recently extended its runway from 150 meters to 1800 meters in order to accommodate larger aircraft.

CASE STUDY: GREENLAND | ROYAL ARCTIC LINE A/S

Headquartered in Nuuk, Royal Arctic Line Ltd. (RAL) was established in 1993 and is wholly owned by the Greenland Home Rule Government. Greenland's Self-Rule authority has awarded Royal Arctic Line the monopoly concession to sail regularly scheduled routes to, from and between the towns in Greenland and between Greenland and Reykjavik, Iceland, and Aalborg, Denmark, as well as a number of other overseas destinations.

Royal Arctic Line's freight rate is built on a uniform price system, so the price for sailing is the same for all towns. Royal Arctic Line is run on business-related terms, but freight rates are approved by the Self-Rule Government. Royal Arctic Havneservice operates thirteen harbors in Greenland. Royal Arctic Logistics handles forwarding and delivery-services, combined ship/plan and consolidation, and also runs stevedoring in the Greenlandic base harbor in Aalborg.

In addition to Royal Arctic Havneservice and Royal Arctic Logistics, a number of subsidiaries are involved in other markets. Passenger service in Greenland is handled by Arctic Umiaq Line, owned with Air Greenland. Arctic Base Supply, a joint venture with Maersk-owned Danbor Services, is involved in mining and oil projects in Greenland.

Increased oil and gas exploration has increased port activity, as well as building in Nuuk. As a result, plans have been made to build five new ships. The company is one of Greenland's largest employers, with more than 800 employees. The company is also an important provider of training in Greenland: approximately 10 percent of the company's employees in Greenland are trainees.

CASE STUDY: ICELAND | GRUNDARTANGI

The Grundartangi port and industrial site is in a non-residential area on the northern shore of Hvalfjörður, 25 km north of Reykjavík. The site is owned by Associated Icelandic Ports, which runs the harbors and ports of Reykjavík, Grundartangi, Akranes and Borgarnes and is a partnership jointly owned by the municipalities of Reykjavík, Akranes, Hvalfjarðarsveit, Skorradalshreppur and Borgarfjarðarsveit. The AIP-group's income amounts to some 2 billion ISK with the single biggest source being cargo dues from import/export. Income from the leasing of land and real estate is also very important.

This port was opened in 1978 to serve the ferrosilicon plant nearby. In 1998 it was enlarged because of a new aluminium smelter in the vicinity and in 2006 it was enlarged further. The total quay length now is 670 meters. Water depth at the quayside is from 10 to 14 meters.

The deepwater harbor is a key asset for AIP in its plans to berth larger ships and handle more cargo. The basic infrastructure is already in place, with approach roads, utilities and a ship terminal. The port has the potential to become a key satellite harbor for Reykjavik: with the amount of available non-residential land, it can relieve the pressure on existing harbors to make land available for civic development.

Two shipping companies operate scheduled services from Grundartangi and Reykjavík to Europe and North America. A third shipping company operates chartered sailings. AIP provides general port services for ships and operates four tug and pilot boats.

CASE STUDY: ICELAND | PORT OF AKUREYI

Located on Eyjafjordur, Akureyri offers a sheltered natural harbor with three cruise berths and an anchorage for both small and big ships. The port is located approximately 100 miles from the Arctic Circle and remains ice-free throughout the year. The depth of the channel at low tide is about 25 meters, so the port can accommodate both small and large ships. The anchorage has a 1000 m (3281 ft) turning basin with a minimum depth of 25 m (82 ft). The cruise facilities are within walking distance from the town center, and there are approximately 60 cruise ship calls per year.

The town of Akureyi is the administrative, transportation and commercial center of northern Iceland and has a population of about 16,000 people. Akureyi is home to important fishing industries. The town has several fish processing plants and docking facilities for trawlers. Akureyi is also the site of one of the largest hospitals in the country, as well as the University of Akureyri. Akureyri Airport, one of four international airports in Iceland, has scheduled domestic flights, augmented by seasonal scheduled international flights.

CASE STUDY: ICELAND | PORT OF REYKJANES

Helguvik Port, located on Reykjanes peninsula in the township of Reykjanesbaer, is 4 kilometers driving distance from the international airport in Keflavik. Helguvik, being the most recently developed harbor in Reykjanes, provides facilities for vessels sailing the North Atlantic. With industrial sites in the area close to the harbor, there are opportunities for fast growing import or export firms wishing to expand in a new, well-planned industrial area with ready access to the geothermal power on which the Reykjanes region stands.

Helguvik is also the main oil supply and distribution harbor of Reykjanes, with its oil tank facility and cargo handling areas offering improved services for industrial freighters and oil vessels. The oil quay accommodates tankers up to 230m long with a water depth at the quayside of 14 meters.

The Port of Helguvik can accommodate ships up to 200m long with water depth 10m at a 150m long quay with a wharf area behind it. Two new quays with water depth of 12 and 14.5 meters are being built with added container and cargo handling areas. Some large industrial companies are in the process of building factories in Helguvik industrial area, adding to the importance and feasibility of container and cargo handling in Helguvik. Helguvik is a hub for combining sea and air transport on the northern route.

The township of Reykjanes has a population of about 14,000 people, with a hospital, many local schools and other infrastructure. There is a large number of empty apartments and industrial housing available in Asbru Enterprise Park, which is a reinvented NATO military base located next to Keflavik International Airport. Asbru offers academic programs at Keilir, a university campus; a business incubator, and many other projects, such as a green energy research center, a health village and an international data center.

CASE STUDY: ICELAND | KEFLAVIK INTERNATIONAL AIRPORT

Keflavík International Airport is the largest airport in Iceland and the country's main hub for international transportation. It is situated 3.1 km (2.0 mi) west of Keflavík and 50 km (31 mi) southwest of Reykjavík. The airport has two runways: the 10,000-foot-long (3,000 m) and 200-foot-wide (61 m) runways are long enough to support the Antonov An-225.

Keflavík Airport is operated by Isavia Ltd., a private limited company with 100 percent government ownership. Fourteen passenger carriers and three scheduled cargo carriers operate at Keflavik International Airport during the summer season. Icelandair, WOW Air, Delta Airlines, Norwegian Air, easyJet, and SAS provide year-round scheduled service. Most domestic flights are flown from Reykjavík Airport, which lies within 3 km (1.9 mi) from Reykjavík's city centre.

In the summer of 2012, the airport reported a record number of passengers, with one million passengers—a 9 percent increase from previous year during the busiest months of June, July and August. The trend continues with 19 percent increase in September and a predicted 19.8 percent increase till year's end with a total traffic of 2.4 million passengers in 2012.

CASE STUDY: NORWAY | KIRKENES

The region of Sør-Varanger in Norway has supported mining operations for over 90 years and it is the "attitudes and infrastructure that supported the mine" that make Kirkenes the location of so much activity. Combined with its location close to Russia and Norway, Kirkenes is not only a prominent port in Norway but also the whole region. As Arctic activities increase, so does the importance of this port.

The port itself is a deepwater port that is ice-free year round. Its natural landscape protects the harbor from wind and weather. Besides its natural environment, the port has many services and supplies that make it able to receive large tankers and oil rigs. The port also has many intermodal transportation linkages including airports, highways and rail lines that run to Russia and Finland. In addition, the port has the largest indoor dry-dock north of Trondheim that can offer all of the necessary services to ships of all sizes.

These elements make the port an attractive second port for the Russian fishing fleets operating in the Barents Sea. Crew changes and resupplying can occur seamlessly in Kirkenes, and the port has a large cold storage facility for frozen fish. There are over 600 Russian trawlers visiting per year for repair and maintenance, shore based services, crew changes, and supply procurement including fuel, water, provisions and waste handling.

Kirkenes has also become a staging ground for vessels headed into the Arctic to conduct seismological surveys increasing the number of annual vessel calls. As Arctic offshore drilling continues in the Barents, Kirkenes will continue to serves as a resupply point for these ventures. In fact, the port is the only one appointed by the Norwegian Coastal Administration suitable for petroleum processing and offshore supply services. Currently the port is also supporting ship-to-ship transfer operations. An ice reinforced vessel will come from the Arctic and transfer condensate to another vessel that will take it to market. Tourism is another driver for development within the Arctic, and with the increase in polar tourism, Kirkenes has been the destination for many cruise lines including the Norwegian Coastal Express.

CASE STUDY: NORWAY | HAMMERFEST

The town of Hammerfest has a population of about 10,000 people and claims to be the northernmost town, although other towns claim otherwise. The port of Hammerfest, because of its central location to the road system and the airport, is the regional hub of Finnmark in Norway. It has always been supportive of natural resource exploration in the Arctic and supportive of development. In addition to supporting resource exploration and cargo operations, the port also plays host to cruise ships. 2011 saw 22 cruise ship calls transporting 17,500 passengers.

The primary industry in Hammerfest used to be fishing, but the economy drastically changed with the development of the Snøhvit gas field. To export this gas, a liquefied natural gas terminal was build to ship LNG to North American markets. The plant was originally built in 2007, but with the shale gas revolution, there was no longer a market in the United States. The Hammerfest facility was forced to find other markets for gas. One of those markets is Japan. In November 2012, the "Ob River" sailed, with a Russian nuclear powered icebreaker escort, through the Northern Sea Route to deliver much needed natural gas to Japan. This route is about half the distance that would normally be required if the shipments travelled along the traditional route through the Suez Canal. In addition to fishing and gas export, the port also supports aquaculture, oil, transportation and construction.

There are three tugs available from the port: the Boris, Barents and the Banak. These tugs are predominantly responsible for helping LNG tankers as they come into the facility. In addition, StatoilHydro, the operator and owner of the LNG facility, has contracted two helicopters: one for transportation and one for search and rescue. The Norwegian Clean Seas Association for Operating Countries (NOFO), which has a fleet of 25 oil spill response vessels and another 25 tugs, now has several offices open in Hammerfest on standby in case they are needed.

CASE STUDY: RUSSIAN FEDERATION | PORT AND AIRPORT OF MURMANSK

The seaport of Murmansk is one of the largest ice-free ports in Russia. It is located on the coast of Kola Bay in the Barents Sea at 68 degrees 58 minutes N, 33 degrees 05 minutes E. The port is navigated all year round by all sizes of vessels. The main port facilities are located on the western coast of Kola Bay, including the mooring berths of the commercial port (including a passenger area), fishing port, repair shipyard, shipyard, oil terminal, and FSUE Atomflot premises. On the eastern coast of Kola Bay there are a number of small fish and fleet maintenance terminals. Three road-handling terminals (Lavna, Belokamenka, Mokhnatkin) are a part of the Murmansk port, as well as an open road near Kolguev Island (the eastern part of the Barents Sea). Beyond Kola Bay the port owns several terminals designated for anchorage and repair of vessels.

The Port of Murmansk owns approximately 100 mooring berths with a total length of more than 10 km. Approximately 200 stevedoring companies render services in handling of a wide range of cargo: coal, non-ferrous and ferrous metals, Arctic destination containers, apatite concentrate, mineral fertilizers, oil products, crude oil, and refrigerated cargo.

The FSUE "Rosmorport" Murmansk branch provides round-the-clock pilotage services for all kinds of vessels calling at the ports of Murmansk and Kandalaksha, as well as information (consulting) pilot services beyond the mandatory pilotage area. The Murmansk branch Pilotage Service employs 47 pilots: 25 high-grade pilots and 22 second-grade pilots.

The Pilotage Service specialists are highly skilled and experienced professionals, able to execute pilotage operations of any difficulty, in different weather conditions and to all types of vessels (dry cargo vessels, bulk cargo vessels, tankers, nuclear-powered icebreakers, special-purpose devices and platforms) regardless of size and displacement.

Murmansk Airport is the international airport of Murmansk in the Russian Federation, serving both domestic operations and international routes to Norway and Finland. It is located near the town of Murmashi in Murmansk's southern suburbs, 24 kilometers (15 mi) outside the city center. The airport served 276,599 passengers in 2006. It had its peak in 2004, when it received 303,432 passengers, including domestic operations and international routes to Norway and Finland.

CASE STUDY: RUSSIAN FEDERATION | PORT OF VARANDEY

The Port of Varandey is located on the shore of the Barents Sea near Varandey Bay. The port is intended for marine export of oil produced in the north of the Nenets Autonomous region. A year-round port, Varandey admits ice-class vessels with lengths up to 258 m, widths up to 34 m and draughts up to 14 m. OAO Varandey Terminal is the only stevedoring company that works at the port and operates two terminals. To the east of Varandey Bay, at a distance of 22.5 km from the shore, a permanent ice-resistant sea off-loading terminal is equipped. Two branches of the subsea pipeline to transfer oil from the onshore tanks are connected to the terminal. On the western coast of the Varandey Strait there is a cargo terminal with a 200-meter mooring wall. The terminal is used to transfer general cargo in summer and is able to admit vessels with draught up to 3.5m, length up to 120m and width up to 15m.

The Varandey terminal handles the export of commercial crude oil produced in the Timano-Pechora oil province of the Yamalo-Nenets autonomous district in the north of Russia's European Region. To increase exports to Western Europe and North America, LUKOIL expanded the terminal's onshore tank farm to a capacity of 325,000 cubic meters and added two 25-km underwater pipelines, as well as an ice-resistant fixed offshore terminal where the oil is loaded onto tanker ships. LUKOIL loaded the first ice-class tanker at its Varandey oil export terminal on June 2008. The 70,000-ton Vasily Dinkov was headed for the Canadian port, Come By Chance, in Newfoundland.

The Varandey facility consists of an onshore tank; a fixed ice-resistant oil terminal 14 miles offshore, with a height of over 160 feet and a weight of over 11,000 metric tons, including living quarters and a mooring cargo handling system with a jib and a helicopter platform; two underwater pipelines, 32 inches in diameter, connecting the onshore tank battery and the offshore oil terminal; and an oil metering station, auxiliary tanks, pumping station and power supply facilities.

An auxiliary icebreaker and an icebreaking tug are on duty in the vicinity of the terminal, according to LUKOIL. The environmental safety system at Varandey has three levels of security and is fully automated. The terminal has been designed to operate with zero discharge, which means that all industrial and domestic waste is collected in special containers and transported onshore.

CASE STUDY: RUSSIAN FEDERATION | PORT OF ANADYR

Anadyr is the capital and administrative center of Chukotka Autonomous Okrug located in the Far East of the Russian Federation. The federal level seaport of Anadyr is located in the northwest coast of the Gulf of Anadyr in the northern part of the Bering Sea and is the largest in the Chukotka region. Sea routes connect with Petropavlovsk-Kamchatsky, Vladivostok, and Magadan, among other ports. Its capacity allows for the transport of 1 million tons of various cargo. The port is open four months out of the year, July 1 to November 1.

The Port of Anadyr became a branch of Rosmorport Federal State Unitary Enterprise in 2004. Today it is one of the key positions in the organization of port complexes located in the Far East of Russia., and a full member of the Association of Commercial Sea Ports, or ASOP. There are central mechanical-repair workshops for low-tonnage vessels, as well as stations for oil spill response and for search and rescue. The only fully equipped diving group in Chukotka is available for underwater inspections/repairs of vessels and hydraulic engineering construction operations.

CASE STUDY: RUSSIAN FEDERATION | ANADYR AIRPORT

The international airport of Anadyr is located at 64° North across the Ugolnye Kopi estuary from the town of Anadyr. The airport commutes to the city by helicopters all year round and by barge/boats vessels during the summer. Regular flights are scheduled to Magadan, Yakutsk, Khabarovsk and Moscow, and also to all regions of the Chukotka Autonomous Okrug.

The federal state unitary enterprise CHUKOTAVIA was created by the State committee of the Russian Federation on March 24, 1995. That enterprise united 10 airports of Chukotka. The main airport is Anadyr; other branches include Beritgovskiy, Keperveym (Omolon), Lavrentiy, markovo, Shmidt, Pevek. Pevek and Anadyr airports are the only two of federal status and with artificially covered runways. The CHUKOTAVIA enterprise fleet includes MI-8T helicopters, and AN-24 and AN-26 aircraft.

The airport complex includes the airport terminal, which can accommodate about 340 passengers, and a hotel. Airport parking can accommodate about 19 aircraft of different types; helicopters of all types; and many types of smaller foreign aircraft.

CASE STUDY: SWEDEN | THE PORTS OF STOCKHOLM

The Ports of Stockholm comprise a number of port areas, of which Värtahamnen, Frihamnen and Loudden, as well as Stadsgården and Skeppsbron are the most prominent commercially. Other central quays are located at Strömmen and Nybroviken and provide attractive quay-berths for the local passenger traffic.

Värtahamnen, Frihamnen and Stadsgården have extensive ferry services for both goods and passengers traveling to and from Finland and the Baltic countries. Stadsgården and Skeppsbron are the points of arrival and departure for the regular scheduled cruise traffic to and from Mariehamn.

In the summer Stadsgården, Skeppsbron and Frihamnen are the ports favoured by the international cruise liners. Loudden and Norra Värtahamnen house important facilities for supplying Stockholm with oil and fossil fuels.

Frihamnen has one of the most important container terminals on the east coast and grain is exported from here to all four corners of the world. Within the port areas of Stockholm there are also facilities for loading and unloading sand, cement and fuel pellets.

CASE STUDY: SWEDEN | STOCKHOLM ARLANDA AIRPORT

Arlanda is Sweden's largest international airport and acts as an important hub for the Stockholm region and Scandinavia—with flights to 172 destinations around the whole world, and good ground transportation to and from other parts of the Stockholm region.

Swedavia group is a business-driven and state-owned airport, which is responsible for the operation and development of eleven Swedish airports, including Stockholm Arlanda Airport.
This means that Swedavia's revenue comes from customers and that the Swedish state demands a return on its investment. The state has also entrusted Swedavia with operating and developing cost-effective, safe and smoothly functioning airports. At Arlanda this entails a wide range of business activities, including everything from running the airport's own energy company to property leasing and international marketing of Stockholm as a destination.

Stockholm Arlanda Airport also plays a significant role in the welfare state—not only in Sweden as a whole but also in the

Stockholm region. The airport creates new work opportunities, is important to tourism and commerce, and for cultural and knowledge exchanges.

At Stockholm Arlanda Airport there are approximately 250 companies and organisations with about 16,000 employees. The airport indirectly generates an additional 1,000 jobs per million passengers and around 2,000 jobs in the region for taxi drivers, nursery staff, and more. This translates to more than 50,000 jobs in addition to those at the airport itself.

It is important for Arlanda to be an integral part of the region and to work towards advancing the development of this region. This is why the airport participates in various collaboration mechanisms.

CASE STUDY: UNITED STATES / ALASKA | DELONG MOUNTAIN TERMINAL AND RED DOG MINE

The DeLong Mountain Transportation System (DMTS) in Alaska is located on the Chukchi Sea about 12 miles south of Kivalina. It consists of a 52-mile-long haul road leading from Red Dog Mine to a shallow-water dock and storage facility. Red Dog Mine was developed by Teck (formerly Comico) and NANA and is now the largest zinc and lead mine in the world producing over 1.2 million metric tons per year.

The difficulty is being able to transport the mineral ore. The Alaska Industrial Development and Export Authority (AIDEA) financed and built the DMTS. AIDEA is a statutory corporation of the State of Alaska. That means that rather than a normal state agency, AIDEA is a public corporation that funds itself and is able to act more like the private sector. The total $267 million dollar investment was predominately raised through the sale of bonds. The investment is the repaid through a toll on the road and use of port, which means the time frame for returns is dependent on use. AIDEA also believes that similar site near Red Dog will be developed and the need for the DMTS will continue even after the life of Red Dog. The initial construction was completed in 1990 and a port expansion was completed in 2000.

The difficulty with this transportation system is that the sea in that area is only ice-free for about three months out of the year so all port activity must occur between June and September. Ore is trucked to the shore side facility throughout the year and stored in one of two ore concentrate buildings until shipping season. The ore is then loaded onto barges via conveyor. The barges then take transport the ore concentrate to deepwater vessels anchored offshore. The port also serves as the primary import facility for the fuel that is needed for the mine. Food and personnel are delivered via a airstrip that was built to accommodate 737s year-round.

The economic impact is huge especially for a region of Alaska with very few economic opportunities. Between 1989 an 2009, Red Dog provided $921 million in benefits to the regional economy and in the last five years, the mine has paid $749 million in taxes to local, state, and federal governments. The mine also provides 550 high-paying jobs and many more summer construction jobs. All of the opportunities exist because the public-private partnership that helped create the DMTS.

CASE STUDY: UNITED STATES / ALASKA | TED STEVENS ANCHORAGE INTERNATIONAL AIRPORT

The Ted Stevens Anchorage International Airport in Alaska is located at 61° North, but according to Alaska, it is not considered an Arctic airport. Even so, the airport is considered the gateway to Alaska. Anchorage's location makes it one of the busiest airports in the world. The airport is the 4th largest in the world in terms of cargo throughput after Hong Kong, Memphis, and Shanghai. It is also the 2nd largest airport in the United States for landed weight of cargo aircraft after Memphis. FedEx and UPS operate major hubs at the airport, partly because Anchorage is within 9.5 hours of 90% of the industrialized world and equidistant from New York and Tokyo. Also, Lake Hood Seaplane Base at the airport is the largest and busiest floatplane base in the world.

Within Alaska, Anchorage is by far the busiest airport in terms of passengers with about 5 million passengers annually. In 2011, there were more than 50,000 passenger aircraft landings and 42,000 cargo aircraft landings. There are 23 passenger destinations and 49 cargo destinations served from the airport by 45 different air carriers. This traffic peaks in the summertime and the number of passengers in June, July, and August are twice as high as between October and April. Seattle, Washington, which is 2,300 kilometers away, represents 25% of all Anchorage traffic.

Starting on May 15, 2013, Icelandair will be offering non-stop seasonal service between Iceland and Anchorage twice a week through September. Susan Bell, commissioner of the Department of Commerce, Community & Economic Development for the state of Alaska was quoted in PR Newswire saying, "Alaska has long been an inspirational holiday destination for travelers from around the world…we believe Icelandair's new route to Alaska will be hugely successful, and will continue to underscore our role as a premier destination as well as to help us grow in European and Scandinavian markets." 2012 also saw direct flights restored between Anchorage and the Kamchatka Peninsula in Russia.

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APPENDIX C: WORKSHOP MATERIALS

WORKSHOP AGENDA

Arctic Transportation Infrastructure: Response Capacity and Sustainable Development
3-6 December 2012
Reykjavik, Iceland

WORKSHOP PARTICIPANTS

PROJECT-RELATED TERMINOLOGY

Arctic
Arctic Council
Response Capacity
Sustainable Development

LIST OF DATA POINTS AND DEFINITIONS

Maritime
Aviation

LIST OF ARCTIC MARINE AND AVIATION INFRASTRUCTURE

Canada
Denmark—Greenland and Faroe Islands
Finland
Iceland
Norway
Russian Federation
Sweden
United States / Alaska

WORKSHOP MATERIALS: AGENDA

PROJECT BACKGROUND

Increased resource extraction to support economic and community development and increased shipping traffic through Arctic waters have resulted in the corresponding need for an increased capacity to respond by sea and air. Arctic ports and airports serve as an important base for response, acting as a gateway to support SAR, resource extraction and development activities, pollution prevention and environmental safety, and community health and security.

The Arctic Council's Sustainable Development Working Group (SDWG) approved a project during the Swedish Chairmanship (co-led by the United States and Iceland) to assess transportation infrastructure. The Arctic Maritime and Aviation Transportation Infrastructure Initiative (AMATII) seeks to evaluate Northern infrastructure—ports, airports, and response capability—by inventorying maritime and aviation assets in the Arctic.

Case studies and illustrative stories of northern aviation and maritime infrastructure—contributed by participants—will serve to highlight the challenges of infrastructure development in the Arctic and its role in facilitating sustainable development. Proceedings from the workshop, along with anecdotal information and other resource documents, will be incorporated into a guidance document to provide the SDWG with policy-relevant information.

Monday, 3 December 2012

<table>
<tr><td>14.00-16.00</td><td colspan="2">Registration</td></tr>
<tr><td>16.00</td><td colspan="2">Welcome and opening remarks—Drue Pearce, Chair, Institute of the North
Group introductions and expectations—Nils Andreassen, Executive Director, Institute of the North
Goals, process and outcomes for small group sessions</td></tr>
<tr><td rowspan="2">17.00</td><td colspan="2">Small group brainstorming and crowd sourcing of definitions/terminology</td></tr>
<tr><td>MARITIME
Maritime Chair: CDR Jonathan Spaner, Director of Emerging Policy, U.S. Coast Guard

Technical Expert: Dr. Lawson Brigham, Distinguished Professor of Geography & Arctic Policy, University of Alaska Fairbanks, United States</td><td>AVIATION
Aviation Chair: Dr. Thorgeir Palsson, Professor of Air Navigation Technology, Reykjavik University

Technical Expert: Ingi Thor Gudmundsson, Director of Sales and Marketing, Air Iceland</td></tr>
<tr><td>18.00-20.00</td><td colspan="2">Welcome reception sponsored by Arctic Shipping Ltd.
Welcome toast—Hjalmar W. Hannesson, Senior Arctic Official, Iceland</td></tr>
</table>

Tuesday, 4 December 2012

<table>
<tr><td>07.30</td><td colspan="2">Coffee and pastries</td></tr>
<tr><td>08.00-09.00</td><td colspan="2">Plenary session: SAREX 2012
LT Snorre Greil, Icelandic Coast Guard</td></tr>
<tr><td rowspan="2">09.00-10.30</td><td colspan="2">Breakout sessions—aviation and maritime discussions begin
Current infrastructure and response
• What infrastructure is currently in place to respond to an emergency and/or to support community resupply or resource development activities?
Review AMATII map of port and airport locations/information. Discuss missing elements, comment on current infrastructure, add data.</td></tr>
<tr><td>MARITIME SESSION
Facilitator: Sarah Barton, ConsultNorth

Session Chair: Vladimir Kharlov,
Trans-NAO Shipping</td><td>AVIATION SESSION
Facilitator: Patrick Juneau, Transport Canada

Session Chair: Steve Hatter, Alaska Department of Transportation and Public Facilities</td></tr>
<tr><td>10.30</td><td colspan="2">Health break</td></tr>
<tr><td>11.00-12.00</td><td colspan="2">Interactive plenary session—moderated by Drue Pearce with Nils Andreassen
• How can we effectively evaluate the current capacity to respond in the Arctic?</td></tr>
<tr><td>12.00-13.30</td><td colspan="2">Lunch and panel discussion—Arctic Mapping Efforts
• Martin Skedsmo, Norwegian Maritime Authority and Arctic SDI
• Halldór Jóhannsson, Arctic Portal
• Sergey Balmasov, Centre for High North Logistics
“Aviation System in Iceland: Infrastructure, Organizations and Supporting Industries for Arctic Transport”
• Guðjón Atlason, Icelandic Civil Aviation Administration</td></tr>
<tr><td rowspan="2">13.30-15.30</td><td colspan="2">Current and future activity
• How does current and projected future activity affect decisions regarding infrastructure development?
Discuss the trends that you are noticing, including efforts to better track increasing activity. Reflect on public and private sector responses to change and the ability to provide supportive infrastructure in the face of that change.</td></tr>
<tr><td>MARITIME SESSION
Facilitator: Sarah Barton, ConsultNorth

Session Chair: Tero Vauraste, Arctia Shipping, Finland</td><td>AVIATION SESSION
Facilitator: James Hemsath

Session Chair: Haukur Hauksson, Isavia</td></tr>
<tr><td>15.30</td><td colspan="2">Health break</td></tr>
<tr><td>16.00-17.00</td><td colspan="2">Interactive plenary session—moderated by Drue Pearce with Nils Andreassen
• From a systems perspective, how does marine and aviation transportation respond to (and plan for) increasing activity?</td></tr>
</table>

Wednesday, 5 December 2012

<table>
<tr><td>07.30</td><td colspan="2">Coffee and pastries</td></tr>
<tr><td>08.00-09.00</td><td colspan="2">Plenary: Scenario—Marine Disaster Incident under AAMSR
Liane Benoit and Sara French, Munk-Gordon Arctic Security Program</td></tr>
<tr><td>09.00-10.30</td><td colspan="2">Infrastructure and investment
• What legal, regulatory and fiscal mechanisms facilitate intermodal infrastructure investment?
Review and discuss facilitative elements for infrastructure development. Discuss these as components of planning efforts by states, municipalities and industry.</td></tr>
<tr><td></td><td>MARITIME SESSION
Facilitator: Sarah Barton, ConsultNorth

Session Chair: Tero Vauraste,
Arctia Shipping, Finland</td><td>AVIATION SESSION
Facilitator: James Hemsath

Session Chair: Haukur Hauksson, Isavia</td></tr>
<tr><td>10.30</td><td colspan="2">Health break</td></tr>
<tr><td>11.00-12.00</td><td colspan="2">Interactive plenary session—moderated by Drue Pearce with Nils Andreassen
• How do we plan for growth potential in Arctic intermodal infrastructure development?</td></tr>
<tr><td>12.00-14.00</td><td colspan="2">Christmas buffet</td></tr>
<tr><td>14.00-16.00</td><td colspan="2">Infrastructure and sustainable development
• How do you leverage growth, change and increased activity to inform sustainable development?
Discuss this in terms of social and economic development, taking into account environmental and cultural considerations. Review the risk-reward process in decision-making.</td></tr>
<tr><td></td><td>MARITIME SESSION
Facilitator: Sarah Barton, ConsultNorth

Session Chair: CAPT Asgrimur L. Asgrimsson,
Icelandic Coast Guard</td><td>AVIATION SESSION
Facilitator: Patrick Juneau

Session Chair: Niels Grosen, Greenland Airport Authority</td></tr>
<tr><td>16.00</td><td colspan="2">Health break</td></tr>
<tr><td>16.30-17.30</td><td colspan="2">Interactive plenary session—moderated by Drue Pearce with Nils Andreassen
• How can communication and data-sharing support decision-making processes?</td></tr>
<tr><td>17.30-19.30</td><td colspan="2">Reception offsite
Hosted by the Icelandic Coast Guard and the Icelandic Ministry of Interior</td></tr>
</table>

Thursday, 6 December 2012

07.30	Coffee and pastries
08.00-09.00	Morning announcements
08.30-11.30	Interactive plenary session—*moderated by Drue Pearce with Nils Andreassen* **What's next?** • Summary of prevailing themes and key considerations—Session Chairs and Technical Experts • What else do we need to know? Based on the AMATII data and the workshop's discussions, discuss cross-cutting themes, surprises or remaining questions. • Final remarks and project next steps—AMATII Phase 2

WORKSHOP SPONSORS AND PARTNERS

GOVERNMENT PARTNERS
Government of Iceland
State of Alaska
University of Alaska Fairbanks

GOLD SPONSOR
Shell Alaska

RECEPTION SPONSOR
Arctia Shipping, Ltd.
Icelandic Coast Guard

PROJECT PARTNERS

U.S. Department of State
Government of Iceland
Transport Canada
State of Alaska
Arctic Portal
Shell
U.S. Department of Transportation Maritime Administration
University of Alaska Fairbanks
Walter and Gordon Duncan Foundation
Canadian Centre for Global Security Studies, Munk School of Global Affairs, University of Toronto

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Asgrimur Asgrimsson, Icelandic Coast Guard
Guðjón Atlason, Icelandic Civil Aviation Administration
Sergey Balmasov, Centre for High North Logistics
Sarah Barton, ConsultNorth
Liane Benoit, Walter and Duncan Gordon Foundation
Hordur Blondal, Port of Akureyri
Dr. Lawson Brigham, University of Alaska Fairbanks
Will Estrada, NAV CANADA
Fridthor Eydal, Isavia
Drummond Fraser, Transport Canada
Sara French, Walter and Duncan Gordon Foundation
LT Snorre Greil, Icelandic Coast Guard
Benedikt Th. Grondal, Icelandic Civil Aviation Administration
Niels Grosen, Greenland Airport Authority
Ingi Thor Gudmundsson, Air Iceland
Magnús Guðmundsson, National Land Survey of Iceland
Pétur Haflidason, Eagle Air
Julius Hafstein, Ministry for Foreign Affairs, Department of External Trade
Mowgli Hallehn, Swedish Maritime Administration
Gudmundur Hallgrimsson, Icelandic Coast Guard
Ambassador Hjalmar W. Hannesson, Senior Arctic Official, Iceland
Steve Hatter, State of Alaska Dept of Transportation and Public Facilities
Haukur Hauksson, Isavia
Hilmar Helgason, Icelandic Coast Guard
James Hemsath, Alaska Industrial Development and Export Authority
Allan Holm, Danish National Police Department
Halldór Jóhannsson, Arctic Portal
Petur Johannsson, Port of Reykjanes
Patrick Juneau, Transport Canada
Sigurður Steinar Ketilsson, Icelandic Coast Guard
Vladimir Kharlov, Trans-NAO Shipping
Auðunn F. Kristinsson, Icelandic Coast Guard
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Andrew Metzger, University of Alaska Fairbanks Institute of Northern Engineering
Embla Eir Oddsdóttir, Northern Research Forum
Dr. Thorgeir Palsson, Reykjavik University

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Hjalti Sæmundsson, Icelandic Coast Guard
Atli Már Sigurðsson, Ministry for Foreign Affairs Iceland
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Martin Skedsmo, Norwegian Mapping Agency
Vladimir Skurikhin, Vertical-T Air Company
Capt. David Snider, The Nautical Institute
CDR Jonathan Spaner, U.S. Coast Guard
Fridfinnur Skaftason, Ministry of the Interior
Sólrún Svandal, Ministry for Foreign Affairs Iceland
Már Sveinbjörnsson, Hafnarfjarðarhöfn
Eirikur Omar Sveinsson, Isavia - Keflavik Airport
Gísli H. Sverrisson, Port of Reykjanes
Steve Theno, PDC Inc. Engineers
Jorundur Valtysson, Defence Department of Iceland
Tero Vauraste, Arctia Shipping
Gisil Viggosson, Icelandic Maritime Administration
Ambassador Stewart Wheeler, Embassy of Canada to Iceland
Sigurður Wium, Icelandic Coast Guard

STAFF

Nils Andreassen, Institute of the North
Kristina Baiborodova, Institute of the North
Geoff Cooper, Institute of the North
Abigail Enghirst, Institute of the North
Nancy Hemsath, Institute of the North

WORKSHOP MATERIALS: AMATII PROJECT-RELATED TERMINOLOGY

ARCTIC

The database examined ports and airports within each nation's geographic definition of Arctic.

For ports the area was designated everything above 60° plus additional areas as requested by individual nations:

- Canada - includes Port of Skagway (Alaska), Port of Churchill, and portions of Nunavik (Quebec) and northern Labrador and Newfoundland
- Greenland - all
- Faroe Islands - all
- Iceland - all
- Norway - north of 60°
- Sweden - north of 60°
- Finland - north of 60°
- Russia - north of 60° and the Bering Sea
- United States/Alaska - coastline along the Bering Sea, Chukchi Sea, and Beaufort Sea

ARCTIC COUNCIL

From the Arctic Council website, http://www.arctic-council.org:
The Ottawa Declaration of 1996 formally established the Arctic Council as a high level intergovernmental forum to provide a means for promoting cooperation, coordination and interaction among the Arctic States, with the involvement of the Arctic Indigenous communities and other Arctic inhabitants on common Arctic issues, in particular issues of sustainable development and environmental protection in the Arctic.

Arctic Council Member States are Canada, Denmark (including Greenland and the Faroe Islands), Finland, Iceland, Norway, Russian Federation, Sweden, and the United States of America.

In addition to the Member States, the Arctic Council includes Permanent Participants, organizations of Indigenous peoples with a majority of Arctic Indigenous constituency representing a single Indigenous people resident in more than one Arctic State; or more than one Arctic Indigenous people resident in a single Arctic State. These Permanent Participants (PPs) have full consultation rights in connection with the Council's negotiations and decisions: Arctic Athabaskan Council, Aleut International Association, Gwich'in Council International, Inuit Circumpolar Council, Russian Arctic Indigenous Peoples of the North, and Saami Council.

The Council's activities are conducted in six working groups: Arctic Contaminants Action Program (ACAP), Arctic Monitoring and Assessment Programme (AMAP), Conservation of Arctic Flora and Fauna (CAFF), Emergency Prevention, Preparedness and Response (EPPR), Protection of the Arctic Marine Environment (PAME), and the Sustainable Development Working Group (SDWG).

RESPONSE CAPACITY

From the 2009 Arctic Marine Shipping Assessment Report, http://pame.is/amsa-2009-report:
Emergency response capacity for saving lives and pollution mitigation is highly dependent upon a nation's ability to project human and physical resources over vast geographic distances in various seasonal and climatic circumstances. The current lack of infrastructure in all but a limited number of areas, coupled with the vastness and harsh environment, makes carrying out a response significantly more difficult in the Arctic. Without further investment and development in infrastructure, only a targeted fraction of the potential risk scenarios can be addressed.

SUSTAINABLE DEVELOPMENT

From the SDWG website, http://portal.sdwg.org/:
The Sustainable Development Framework Document was adopted by the Ministerial meeting in Barrow in 2000, outlining the elements of the SD Program and identifying six subject areas under the heading of sustainable development of special importance:

- Health issues and the well-being of people living in the Arctic
- Sustainable economic activities and increasing community prosperity
- Education and cultural heritage
- Children and youth
- Management of natural, including living, resources
- Infrastructure development

Sustainable development has been defined in many ways, but the most frequently quoted definition is from Our Common Future, also known as the Brundtland Report: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

WORKSHOP MATERIALS: DATA POINTS & DEFINITIONS

Arctic Airports Database

Location:
- Country
- Region
- Airport Name
- City
- ICAO Code
- IATA Code
- Latitude
- Longitude
- Airport Type
- Airport Size
- Distance to City (kilometers)
- Distance to Closest International Airport
- Population
- Time Zone

Operations (management):
- Operating Agency
- Hours of Operation
- Contact
- Telephone Number
- Fax Number
- Address
- Mail
- Email
- Website
- Customs
- Annual Aircraft Movement
- Annual Domestic Passengers
- Annual International Passengers
- Annual Cargo (tonnes)

Physical Attributes:
- Number of Runways
- Runway Dimensions (meters)
- Runway Surface
- Runway Load
- Runway Lights
- Load/Offload Capacity
- Restrictions
- Helipad
- Terminal Availability
- Hangar Space
  - Size
  - Heated
- Auxiliary Equipment Available

Arctic Maritime Database

Location:
- Country
- Region
- Port Name
- City
- World Port Index
- UN/LOCODE
- Chart number
- Latitude
- Longitude
- Port Type
- Port Size
- Distance to City (kilometers)
- Population of City
- Time Zone

Operations (management):
- Operating Agency
- Seasons of Operations
- Primary function
- Website
- First Port of Entry
- ETA Required
- Annual Vessel Calls
- Annual Domestic Passengers
- Annual International Passengers
- Annual Cargo (tonnes)

Physical Attributes:
- Cranes (Fixed, Mobile, Floating)
- Lifts (tonnes: 0-24, 45-49, 50-100, 100+)
- Load/Offload (Wharves, Anchor, Med Moor, Beach Moor, Ice Moor)
- Dry Dock (Small, Medium, Large)
- Marine Railway (Small, Medium, Large)
- Shelter Afforded (Excellent, Good, Fair, Poor, None)
- Entrance Restrictions (Tide, Swell, Ice, Other)
- Good Holding Area
- Turning Area
- Water Depth (meters)
  - Channel
  - Anchorage
  - Cargo Pier
  - Fuel Terminal
  - Tide
- Vessel LOA (meters)
- Overhead Restrictions

Arctic Airports Database continued

Services, Supplies, and Communications:

- Medical Assistance
- Firefighting Capability
- Response:
  - Access to SAR
  - HAZMAT
- Communications
  - ATC Services
  - Primary Communication Frequency
  - Telephone
  - Telefax
- Navigation Aids
  - Weather Services
  - Maximum ILS capability
  - Airport Navaids
- Supplies
  - Fuel
  - Deice
  - Provisions
  - Water
- Maintenance (Staffed, On Call, Limited)
- Disposal Services
- Repair (Major, Moderate, Limited, Emergency)

Arctic Maritime Database continued

Services, Supplies, and Communications:

- Medical Facilities
- Firefighting Capability
- Response:
  - Access to SAR
  - Access to Oil Spill Cleanup
  - HAZMAT
  - Tugs (Salvage, Assist)
- Communications
  - Telephone
  - Telefax
  - Radio
  - Radio Telephone
  - Air
  - Rail
- Navigation
  - Navigation Equipment
  - Pilotage (Compulsory, Available, Local Assist, Advisable)
- Supplies
  - Provisions
  - Water
  - Fuel Oil
  - Diesel Oil
  - LNG
  - Deck
  - Engine
- Services
  - Longshore
  - Electricity
  - Steam
  - Dirty Ballast Offload
  - Garbage Disposal
- Repair (Major, Moderate, Limited, Emergency)

Data Points Defined | AVIATION

Location

- Country – Where the airport is located
- Region – Where the airport is located
- Airport Name – The official name of the airport
- City – Where the airport is located
- ICAO Code – The International Civil Aviation Organization (ICAO) Code or location indicator is a four-character alphanumeric code designation for each airport
- IATA Code – International Air Transportation Association (IATA) assigns 3-letter IATA airport codes and 2-letter IATA airline designations
- Latitude and Longitude – Position in decimal form (rounded to six decimal places)
- Airport Type – Indicates Cargo, Passengers, or Both
- Airport Size – Indicates relative size as Small, Medium, or Large
- Distance to City – The distance to the closest city (in kilometers)
- Distance to Closest International Airport – The distance to the closest international airport (in kilometers)
- Population – Population of the closest city
- Time Zone – Time zone (relative to UTC)

Operations (management)

- Operating Agency – Primary operator of this airport
- Hours of Operation – Hours when the airport is open
- Contact information
  - Name of management
  - Telephone Number
  - Fax Number
- Address – Address of the main office
  - Mail – Physical address
  - Email – Email address
- Website – URL of airport website
- Customs – An indicator of the availability of Customs and Immigration personnel at the airport
- Annual Aircraft Movement – The number of aircrafts transiting the airport
- Annual Domestic Passengers – The number of domestic passengers traveling through the airport
- Annual International Passengers – The number of international passengers traveling through the airport
- Annual Cargo – The amount of cargo transported through the airport (in metric tons)

Physical Attributes

- Number of Runways – Number of runways available at the airport
- Runway Dimensions – The dimensions of the available runways (in meters)
- Runway Surface – Type of runway surface(s)
- Runway Load – Runway loading limits
- Runway Lights – Type of runway lights
- Load/Offload Capacity – Loading and off-loading limits and capabilities
- Restrictions – Type of restrictions, if any
- Helipad – Availability of a helipad
- Terminal Availability – Indication of an available terminal at the airport
- Hangar Space – Indicates hangar space and type, if available
  - Size
  - Heated
- Auxiliary Equipment Available – Indicates availability of portable equipment such as jet ways, plug-ins, etc.

Services, Supplies, and Communications

- Medical Assistance – Availability and type
- Firefighting Capability – Availability and type
- Response: An indication of the availability of response and type, if available
  - Access to SAR (Search and Rescue) capability
  - HAZMAT
- Communications – An indication of the communications available for aviation
  - ATC Services
  - Primary Communication Frequency – and frequency
  - Telephone
  - Telefax
- Navigation Aids – An indication of the aids to navigation (navaids) available at the airport and type
  - Weather Services
  - Maximum ILS Capability – An indication of the maximum capability of Instrumental Landing System (ILS)
  - Airport Navaids
- Supplies – An indication of supplies at the airport and type
  - Fuel
  - Deice
  - Provisions
  - Water
- Maintenance – An indication of the availability of maintenance at the airport: Staffed, On Call, or Limited
- Disposal Services – An indication of the availability of disposal services at the airport
- Repair – An indicator of the level of repair available at the airport: Major, Moderate, Limited, or Emergency

Data Points Defined | MARITIME*

Location

- Country – Where the port is located
- Region – Where the port is located
- Airport Name – The official name of the port
- City – Where the port is located
- World Port Index – United States National Geospatial-Intelligence Agency index number
- UN/LOCODE – United Nations Code for Trade and Transport Locations
- Chart Number – The number of the best-scale chart issued by the National Geospatial-Intelligence Agency. Some international charts are listed as well by prefix
- Latitude and Longitude-Position in decimal form
- Port Type – Describes the physical layout of the port (coastal natural, coastal breakwater, open roadstead, river/canal)
- Port Size – Size indication is dependent on several factors including area, facilities and wharf space (very small, small, medium, large)
- Distance to City – Distance to closest city (kilometers)
- Population of City – Population of closest city
- Time Zone – Time zone (relative to UTC)

Operations (management)

- Operating Agency – The primary operator of the port
- Seasons of Operation – Operating seasons
- Website – URL address of the port website
- First Port of Entry – A port where a vessel may enter and clear foreign goods and personnel through Customs and Immigration
- ETA Required – An indication of whether an Estimated Time of Arrival message is required in advance of arrival
- Annual Vessel Calls – The number of vessels that make call per year
- Annual Domestic Passengers – The number of domestic passengers per year
- Annual International Passengers – The number of international passengers per year
- Annual Cargo – The amount of cargo imported and exported per year (metric tonnes)

Physical Attributes

- Cranes – An indication of the availability of cranes and type (Fixed, Mobile, Floating)
- Lifts – An indication of the lifting power of the cranes (tonnes: 0-24, 45-49, 50-100, 100+)
- Load/Offload – An indication of where normal port operations are conducted (Wharves, Anchor, Med Moor, Beach Moor, Ice Moor)
- Dry Dock – An indication of size and availability of drydock (Small is under 200m, Medium is 201-300m, Large is 301m+)
- Marine Railway – An indicator of the size and availability of marine railway (Small, Medium, Large)
- Shelter Afforded –The shelter afforded from wind, sea, and swell, refers to the area where normal port operations are conducted, usually the wharf area (Excellent, Good, Fair, Poor, None)
- Entrance Restrictions – Natural factors restricting the entrance of vessels (Tide, Swell, Ice, Other)
- Good Holding Area – This is indicated only where actual anchorage conditions have been reported
- Turning Area – An indication that a turning basin or other water area for turning vessels is available in the port
- Water Depth – Depths are given in increments of 1.5 meters in order to lessen the number of changes when a small change in depth occurs
  - Channel
  - Anchorage
  - Cargo Pier
  - Fuel Terminal
  - Tide
- Vessel LOA – Vessel Length Overall (in meters)
- Overhead Restrictions – This entry is shown only to indicate that bridge and overhead power cables exist

Services, Supplies, and Communications

- Medical Facilities – An indication that there is some form of medical facilities in the port
- Firefighting Capability – An indication that there is some form of firefighting capability in the port
- Response:
  - Access to SAR – An indication that there is some form of search and rescue capability
  - Access to Oil Spill Cleanup – An indication that there is some form of oil spill cleanup method
  - HAZMAT – An indication that the port has a way of handling hazardous materials
  - Tugs – Indicates whether tugs are available for docking/anchorage assistance or salvage (Salvage, Assist)
- Communications – An indication that the following communication methods are available:
  - Telephone
  - Telefax
  - Radio
  - Radio Telephone
  - Air
  - Rail
- Navigation:
  - Navigation Equipment – An indication that there is some form of navigation equipment
  - Pilotage – Indicates the requirement/recommendation for pilotage (Compulsory, Available, Local Assist, Advisable)
- Supplies – An indication that the following supplies are available at the port:
  - Provisions
  - Water
  - Fuel Oil
  - Diesel Oil
  - LNG
  - Deck
  - Engine
- Services – An indication that the following services are available at the port:
  - Longshore
  - Electricity
  - Steam
  - Dirty Ballast Offload
  - Garbage Disposal
- Repair – An indicator of the level of repair available at the port (Major, Moderate, Limited, Emergency)

*Note: many of the marine definitions are taken directly from the World Port Index, 2011 produced by the United States National Geospatial-Intelligence Agency.

WORKSHOP MATERIALS: LIST OF ARCTIC MARITIME AND AVIATION INFRASTRUCTURE

CANADA | Ports

Akulivik
Arctic Bay
Arviat
Aupaluk
Bathurst Inlet
Bernard Harbor
Cambridge Bay
Cape Dorset (Kinngait)
Cape Young
Chesterfield Inlet
Churchill
Clyde River
Coral Harbour
Eureka
Gjoa Haven
Grise Fiord
Hall Beach
Hopedale Harbor
Igoolik
Inukjuak
Iqaluit
Ivujivik
Kangiqsualujjuaq
Kangiqsujuaq
Kangirsuk (Maricourt)
Killiniq (Port Burwell)
Kimmirut (Lake Harbor)
Kugluktuk (Coppermine)
Kuujjuaq (Fort Chimo)
Kuujjuarapik
Lady Franklin Point
Milne Inlet
Nain
Nanisivik
Padloping Island
Pangnirtung
Paulatuk
Pearce Point
Police Point
Pond Inlet (Mittimatalik)
Puvirnituq
Qikiqtarjuaq
Quaqtaq
Rankin Inlet
Resolute Bay (Quaasuittuq)
Rigolet
Sachs Harbour (Ikaahuk)
Saglek Bay
Salluit (Sugluk Inlet)
Sanikiluaq
Steensby Inlet
Taloyoak (Spence Bay)
Tasiujaq
Tuktoyaktuk
Tysoe Point
Ulukhaktok
Umingmaktok
Umiujaq
Whale Cove
Whapmagoostui

CANADA | Airports

Aklavik
Akulivik
Alert (CFS Alert)
Arctic Bay
Arviat
Aupaluk
Baker Lake
Beaver Creek
Braeburn
Burwash
Cambridge Bay
Cape Dorset
Carcross
Carmacks
Chapman
Chesterfield Inlet
Churchill
Clyde River
Colville Lake
Coral Harbour
Dawson City
Deline
Diavik
Ekati
Eureka
Faro
Finlayson Lake
Ford Bay
Fort Good Hope
Fort Liard
Fort McPherson
Fort Providence
Fort Resolution
Fort Selkirk
Fort Simpson
Fort Simpson Island
Fort Smith
Goose Bay
Gjoa Haven
Great Bear Lake
Grise Fiord
Haines Junction
Hall Beach
Hay River
Hopedale
Hyland
Igloolik
Inukjuak
Inuvik Mike Zubko
Iqaluit
Ivujivik
Kangirsuk
Kangiqsualujjuaq
Kangiqsujuaq
Kattiniq/ Donaldson
Kimmirut
Kugaaruk
Kugluktuk
Kuujjuaq
Kuujjuarapik
La Biche River
Lutselk'e
Macmillan Pass
Makkovik
Mayo
McQuesten
Minto
Mule Creek
Nahanni Butte
Nain
Nanisivik
Norman Wells
Obre Lake
Ogilvie
Old Crow
Pangnirtung
Paulatuk
Pelly Crossing
Pine Lake
Pond Inlet
Puvirnituq
Postville
Qikiqtarjuaq
Quaqtaq
Rankin Inlet
Repulse Bay
Resolute Bay
Rigolet
Ross River
Sachs Harbour
Salluit
Sanikiluaq
Silver City
Snare River
Taloyoak
Taltheilei Narrows
Tanquary Fiord
Tasiujaq
Teslin
Trout Lake
Tuktoyaktuk/James Gruben
Tulita
Tungsten (Cantung)
Twin Creeks
Ulukhaktok/ Holman
Umiujaq
Watson Lake
Wekweeti
Whale Cove
Whati
Whitehorse (Cousins)
Whitehorse International
Wiley
Wrigley
Yellowknife

FAROE ISLANDS | Ports

Fuglafjordur
Kongshavn
Thorshavn
Tvoroyri

FAROE ISLANDS | Airport

Vágar

FINLAND | Ports

Hamina (Fredrikshamn)
Hanko (Hangö)
Helsinki
Inkoo (Ingå)
Jakobstad (Pietarsaari)
Kaskinen (Kaskö)
Kemi/Torneå
Kokkola (Karleby)
Kotka
Loviisa (Lovisa)

Mäntyluoto
Naantali (Nådendal)
Pori (Björneborg)
Porvoo (Borgå)
Rahja
Rauma
Roytta
Tahkoluoto
Tornio
Turku (Åbo)
Uusikaupunki (Nystad)
Vaasa (Vasa)
Vuosaari Harbor

FINLAND | Airports

Enontekio
Helsinki-Malmi
Helsinki-Vantaa
Ivalo
Joensuu
Jyvaskyla
Kajaani
Kemi-Tornio
Kittila
Kokkola-Pietarsaari/
Kruunupyy
Kuopio
Kuusamo
Lappeenranta
Mariehamn (Maarianhamina)
Mikkeli
Oulu
Pori
Rovaniemi
Savonlinna
Tampere-Pirkkala
Turku
Utti
Vaasa
Varkaus

GREENLAND | Ports

Aasiaat Qasigiannguit
Attu
Faeringehavn
Gronnedal (Kangilinguit)
Ilulissat
Kajalleq Upernavik
Kangamiut
Kangerlussuaq (Sondre
Stromfjord)
Kangerlusuaq
Kusanartoq
Maniitsoq
Marmorilik
Nanortalik
Narsaq
Narssarssuaq
Niaqornat
North Star Bugt
Nuuk
Paamuit
Qaanaaq (Thule Air Base)
Qaqortoq
Qeqertarsuaq
Qutdleq
Shab
Sisimiut
Soendre Stroemfjord
Tasiilaq
Upernavik
Uummannaq Harbor

GREENLAND | Airports

Aasiaat
Akunaq
Alluitsup Paa
Ammassalik
Ammassavik
Appilatoq (NAN)
Appilattoq
Attu
Eqalugaarsuit
Iginniarfik
Ikamiut
Ikerassaarsuk
Ikerassaq
Ilimanaq
Illorsuit
Ilulissat
Innarsuit
Isortoq
Kangaatsiaq
Kangerlussuaq Sondre
Stromfjord
Kangersuatsiaq
Kangilinuit
Kitsissuarsuit
Kullorsuaq
Kulusuk
Kuummiut
Maniitsoq
Nanortalik
Narsaq
Narsaq Kujl.
Narsarsuaq
Niaqornait
Niaqornarsuaq
Nuuk Godthab
Nuussuaq
Paamiut
Qaarsut
Qaqortoq
Qasigiannguit
Qassimiut
Qeqertaq
Qeqertarsuaq
Saattut
Saqqaq
Savissivik
Sermiligaaq
Sisimiut
Tasiusaq
Tasiusaq (NAN)
Tinnitiqilaaq
Ukkusissat
Upernavik
Upernavik Kujl.
Uummannaq

ICELAND | Ports

Akranes
Akureyri
Bildudalur
Blonduos
Bolungavik
Budir
Dalvik
Djupivogur
Eskifjordur
Faskrudsfjordur
Grenivik
Grindavik
Grundarfjödur
Grundartangi
Hafnarfjordur
Helguvik
Hornafjordur
Husavik
Hvammstangi
Isafjordur
Kapavogur
Keflavik
Kopasker
Mjoeyrarhofn
Neskaupstadur
Njarovik
Olafsfjørdur
Raufarhöfn
Reydarfjordur
Reykjavik
Sandgerdi
Saudarkrokur
Seydisfjordur
Siglufjørdur
Skagaströnd
Stodhvarfjordur
Straumsvik
Thingeyri
Vestmannaeyjar
Vopnafjordhur

ICELAND | Airports

Akureyri
Bildudalur
Egilsstadur
Gjogur
Grimsey
Grundafjordur (Bakki)
Hornafjordur
Husavik
Isafjordur
Keflavik NAS
Norfjordur
Reykjavik
Rif
Saudarkrokur
Thingeyri
Thorshofn
Vestmannaeyjar
Vopnafjordur

NORWAY AND SVALBARD | Ports

Ålesund
Alta
Åndalsnes
Andenes
Årdalstangen
Ballangen
Ballstad
Barentsburg
Båtsfjord
Berg
Bergen
Berlevåg
Bodø
Brattholmen
Brettesnes
Brevik
Brønnøysund
Bud
Djupvik
Drag
Fauske
Finnsnes
Florø
Gibostad
Glomfjord
Hammerfest
Hamnesberget
Hareid
Harstad

Henningsvær
Herøysundet
Hommelvik
Honningsvåg
Kirkenes
Kjerringoy
Kjøllefjord
Korsnes
Kristiansund
Kvalsund
Lakselv
Langstein
Levanger
Lilandsgrunnen
Lødingen
Longyearbyen
Malm
Måløy
Medby
Mo
Molde
Moltustranda
Mongstad
Mosjøen
Muruvik
Namsos
Narvik
Norheimsund
Ny-Alesund
Odda
Øksfjord
Ørnes
Orstav
Reine
Rognan
Rørvik
Salsbruket
Sandnessjøen
Sjøvegan
Skrova
Sortland
Sørvær
Stamsund
Steinkjer
Stokmarknes
Strandvik
Stura
Sunndalsøra
Svolvaer
Talvik
Thamshamn
Tjøtta
Tranneset
Tranøy
Tromsø
Trondheim
Ulvik
Vadsø
Vaksdal
Vardø

NORWAY AND SVALBARD | Airports

Alta
Andoyo
Banak
Batsfjord
Berievag
Bronnoy
Gardermoen
Hammerfest
Honningsvag
Kjeller
Mehamn
Mo I Rana
Orland
Roros
Rygge
Sorkjosen
Svartnes
Torp
Vadsa
Vaernes

RUSSIAN FEDERATION | Ports

Ambarchik
Amderma
Anadyr
Arkhangelsk
Belomorsk
Beringovsky
Bolshaya Piryu Guba
Dikson
Dudinka
Egvekinot
Igarka
Kandalaksha
Keret
Khatanga
Kovda
Mezen
Murmansk
Mys
Abram
Mys
Novyy
Naryan
Mar
Onega
Ostrovnoy Gremhika
Pevek
Provideniya, Bukhta
Rabocheostrovsk
Severodvinsk
St. Petersburg
Tiksi
Varandey
Vitino

RUSSIAN FEDERATION | Airports

Aldan
Alykel
Amderma
Batagay
Baykit
Beloyarsky
Beringovskiy
Beryozovo
Besovets
Chaybukha
Chersky
Chokurdakh
Chulman
Deputatskiy
Dikson
Igrim
Inta
Izhma
Khatanga
Kogalym
Koslan
Kotlas
Lensk
Leshukonskoye
Markovo
Mirny
Murmansk
Mys Kamenny
Mys Shmidta
Nadym
Naryan Mar
Nefteyugansk
Nikolskoye
Nizhnevartovsk
Novy Urengoy
Noyabrsk
Nyagan
Nyurba
Olekminsk
Olenek
Pechora
Pevek
Poliarny
Provideniya Bay
Pulkovo
Raduzhny
Roschino
Salekhard
Shenkursk
Sokol
Sovetsky
Sredniy
Strezhevoy
Surgut
Syktyvkar
Talagi
Tarko-Sale
Tiksi
Tura
Ugolny
Ugraavia
Ukhta
Uray
Usinsk
Ust-Kamchatsk
Ust-Tsilma
Ust'-Nera
Vilyuysk
Vorkuta
Vuktyl
Yakutsk
Zhigansk

SWEDEN | Ports

Arvidsjaur
Borlange
Froson
Gallivare
Gavle Sandviken
Hagfors
Hallviken
Hemavan
Hudiksvall
Kalixfors
Kallax
Kiruna
Kramfors Solleftea
Lycksele
Mora
Optand
Ornskoldsvik
Orsa
Pajala
Pitea
Skelleftea
Soderhamn
Storuman
Sundsvall Hamosand
Torsby
Umea
Vilhelmina

SWEDEN | Airports

Bollstabruk
Brännfors
Domsjö
Gavle
Grisslehamn
Gumbodahamn
Gustavsvik
Hallstavik
Hargshamn
Härnösand
Hudiksvall
Husum
Iggesund
Kagehamn
Karlsborg
Karskär
Köpmanholmen
Kramfors
Luleå
Lund
Nordmaling
Norrsundet
Obbola
Örebro
Örnsköldsvik
Piteå
Rundvik
Sandarne
Sandviken
Skelleftehamn
Skutskar
Söderhamn
Söråker
Stocka
Stockholm
Stockvik
Sundsvall
Torehamn
Ulfvik
Umeå
Utansjö
Väja
Vallvik
Vivstavarv

UNITED STATES (ALASKA) | Ports

Adak
Akutan Harbor
Anchorage*
Barrow
Bernard Harbor
Bethel
Cold Bay
DeLong Terminal
Dillingham
Dutch Harbor
Homer*
Juneau*
Ketchikan*
King Cove
Kodiak*
Kotzebue
Nome
Petersburg*
Port Clarence
Prudhoe Bay
Seward*
Shismaref
Sitka*
Skagway*
St. George
St. Michael
St. Paul
Unalakleet
Valdez*
Wainwright
Whittier*
Wrangell*

* Indicates ports that support Arctic activity.

UNITED STATES (ALASKA) | Airports

Adak
Akhiok
Akiachak
Akiak
Akutan
Alakanuk
Aleknagik
Allakaket
Allen AAF
Ambler
Anaktuvuk Pass
Angoon SPB
Aniak
Annette Island
Anvik
Atmautluak
Barter Island LRRS
Basin Creek
Beaver
Beluga Lake SPB
Bethel
Bettles
Bettles Vor Lake SPB
Big Lake
Big Mountain
Birchwood
Bob Baker Memorial
Bob Curtis Memorial
Boundary
Brevig Mission
Bryant AHP
Buckland
Cape Lisburne LRRS
Cape Newenham LRRS
Cape Romanzof LRRS
Central
Chalkyitsik
Chandalar Lake
Chandalar Shelf
Chefornak
Chenega Bay
Chevak
Chicken
Chignik
Chignik Bay
Chignik Lagoon
Chignik Lake
Chisana
Chistochina
Chitina
Chuathbaluk
Circle City
Circle Hot Springs
Clark's Point
Clear
Cold Bay
Coldfoot
Copper Center
Craig SPB
Crooked Creek
Dahl Creek
Deadhorse
Deering
Dillingham
Don Hunter, Sr
Eagle
Edak Lake
Edward Burnell Sr Mem
Edward G. Pitka Sr
Eek
Egegik
Eielson AFB
Ekwok
Elfin Cove
Elim
Elmendorf AFB
Emmonak
English Bay
Excursion Inlet SPB
Fairbanks INTL
False Pass
Flat
Fort Yukon
Funter Bay SPB
Galbraith Lake
Gambell
Girdwood
Golovin
Goodnews Bay
Goose Bay
Granite Mountain AFS
Grayling
Gulkana
Gustavus
Haines
Haines SPB
Harris Harbor SPB
Healy River
Hollis SPB
Holy Cross
Homer
Hoonah
Hoonah SPB
Hooper Bay
Hope
Hughes
Huslia
Hydaburg SPB
Hyder SPB
Hyder SPB
Igiugig
Iliamna
Indian Mountain LRRS
James A Johnson
Juneau International
Kake
Kake SPB
Kalskag
Kaltag
Kantishna
Karluk
Kasaan SPB
Kasigluk (Akolmiut)
Kasilof
Kenai Muni
Ketchikan Harbour SPB
Ketchikan INTL
Ketchikan Peninsula Point SPB
King Cove
King Salmon
Kipnuk
Kivalina
Klawock
Klawock SPB
Kobuk
Kodiak
Kokhanok

Koliganek
Kongiganak
Kotlik
Koyuk
Koyukuk
Kuparuk
Kwethluk
Kwigillingok
Lake Hood
Lake Hood SPB
Lake Louise
Larsen Bay
Lawing
Levelock
Lime Village
Little Diomede
Livengood
Loring SPB
Manley Hot Springs
Manokotak
May Creek
McCarthy
McGrath
Mekoryuk
Merrill Field
Metlakatla SPB
Metro Field
Middleton Island
Minchumina
Minto
Moses Point
Mountain Village
Mudhole Smith Memorial
Naknek
Napakiak
Napaskiak
Nelson Lagoon
Nenana Municipal
New Stuyahok
Newtok
Nightmute
Nikolai
Ninilchik
Noatak
Nome
Nome City Field
Nondalton
North Whale Pass SPB
Northway
Nuiqsut
Nulato
Nunapitchuk
Ouzinkie
Palmer Municipal
Pedro Bay
Pelican SPB
Perryville
Pilot Point
Pilot Station
Pioneer Field
Platinum
Point Baker SPB
Point Hope
Point Lay LRRS
Port Alexander SPB
Port Clarence CGS
Port Graham
Port Heiden
Port Heiden
Port Lions
Port Protection SPB
Portage Creek
Prospect Creek
Quartz Creek
Quinhagak
Ralph M Calhoun Mem
Ralph Wien Mem
Rampart
Red Devil
Roundtree SPB
Ruby
Russian Mission
Salmon Lake
Sand Point
Savoonga
Scammon Bay
Selawik
Seldovia
Seward
Shageluk
Shaktoolik
Sheldon Point
Shishmaref
Shungnak
Sitka
Rocky Gutierrez
Skagway
Skagway SPB
Skwentna
Sleetmute
Soldotna
South Naknek
Sparrevohn
St George
St Mary's
St Michael
St Paul Island
Stebbins
Stevens Village
Stony River
Summit
Takotna
Talkeetna
Tanacross
Tatalina LRRS
Tatitlik
Tazlina
Ted Stevens Anchorage
Teller
Tenakee Springs SPB
Thorne Bay SPB
Tin City LRRS
Togiak
Tok Junction
Toksook Bay
Tuluksak
Tuntutuliak
Tununak
Twin Hills
Ugashik
Umiat
Unalakleet
Unalaska/Dutch Harbor
Wainwright
Wainwright AAF
Wainwright AS
Wales
Warm Springs Bay SPB
Wasilla
White Mountain
Whittier
Wiley Post
Will Rogers Mem
Willow
Wiseman
Wolf Lake
Wrangell
Yakutat SPB

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION

ANCHORAGE CONVENTION & VISITORS BUREAU

SARA FRENCH, WALTER AND DUNCAN GORDON FOUNDATION

RANDY MORRIS, NAV CANADA

INSTITUTE OF THE NORTH

INSTITUTE OF THE NORTH

INSTITUTE OF THE NORTH

KOPRI

극지연구소

ARCTIC MARITIME & AVIATION

TRANSPORTATION INFRASTRUCTURE INITIATIVE

AMATII Website, Database and Map Interface and Overview

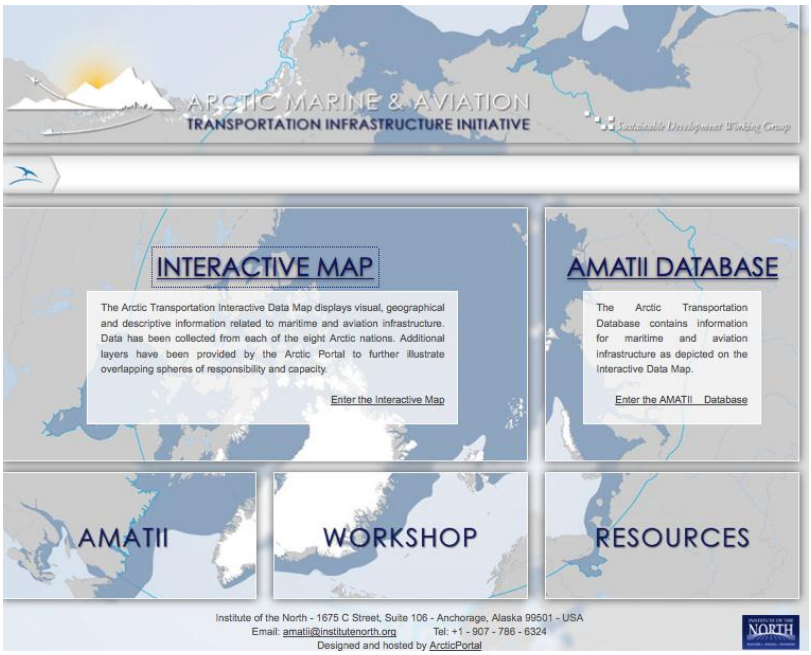
The AMATII Database and Map should be easily accessible on the website developed for the project, www.arcticinfrastructure.org. A screenshot of the home page is below.

On the home page, the user has access to all elements of the project. In addition to the Interactive Map and Database, at the bottom of the page there are three boxes:

- **AMATII** – the project's formational documents, including proposal and 2009 AMSA Report

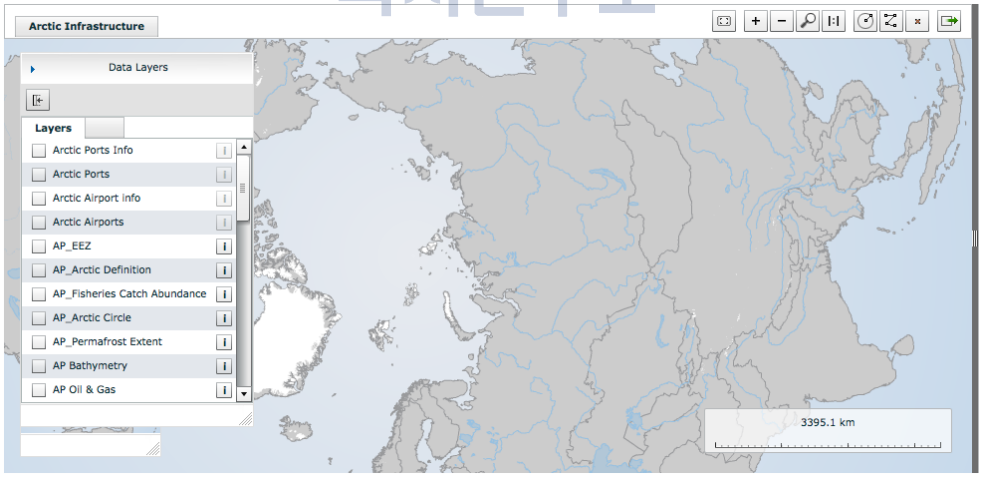
- **WORKSHOP** – materials from the Arctic Transportation Infrastructure Workshop in Reykjavik, including agenda, list of participants and plenary presentations.

- **RESOURCES** – background documents and links to additional information and resources



AMATII home page: www.arcticinfrastructure.org

The primary deliverable of the project, the **INTERACTIVE MAP**, takes the user directly to:



Opening screen for the Interactive Map

The first four items listed under "Data Layers" are the product of the AMATII project. Clicking on **Arctic Ports** and **Arctic Airports** adds to the map the Arctic maritime and aviation infrastructure compiled as part of AMATII**.** The type and size of the dot on the map identifies the significance of the location: maritime infrastructure is indicated as Large/Medium (starred) or Small/Very Small, according to the World Port Index; airports by type, International (starred) or Domestic. By adding **Arctic Ports Info** and **Arctic Airports Info** layers, the user can "mouse over" or hover over the indicators (dots) on the map to

learn more about the location. Other layers provide additional lenses through which to view the infrastructure, such as Permafrost Extent, SAR jurisdictions, etc. Users can add or subtract layers as needed to better understand. There is also the functionality to measure distance by clicking the radius icon.

On the right side of the home page, the user can enter the **AMATII DATABASE** directly, after agreeing to the disclaimer developed for the project.

After choosing either **ARCTIC AIRPORTS** or **ARCTIC MARITIME**, the user will see a list of airports and/or ports/harbors. The list within each sector can be re-configured alphabetically to highlight a number of features, such as name of the facility, region, and country.

*Opening screen for the **AMATII Database***

Additionally, maritime infrastructure can be sorted by World Port Index, UNILO code and chart number. Likewise, aviation information may be sorted by ICAO and IATA codes. A search window can be used to filter choices. Finally, a list of the data can be downloaded from the site in klm (GoogleEarth), shp (database files) or csv (easily converted to Excel) format.

The Institute of the North has created an email address – amatii@institutenorth.org - at which changes, revisions, and comments about the database and interactive map can be received. The Institute will also have access to the working side of the website and map to make those changes.


Search:

Name	Region	Country	World port index	UNILO code	Chart number
Aasiaat Qasigiannguit	East Coast	Greenland	760	GLJCH	28482
Adak	Aleutians (Southwest)	US Alaska	20140	USADK	16471
Akranes	West Coast	Iceland		ISAKR	
Akulivik	Nunavik	Canada		CAAKV	
Akureyri	North Coast	Iceland	310	ISAKU	38681
Akutan Harbor	Aleutians (Southwest)	US Alaska	20097	USKQA	20097
Alta	Finnmark	Norway	21130	NOALF	43084
Ambarchik	Chukotka Autonomous Okrug	Russia	62660		41100
Amderma	Nenets Autonomous Okrug	Russia		RUAMV	
Anadyr	Chukotka Autonomous Okrug	Russia		RUDYR	
Anchorage*	Southcentral	US Alaska	19800	USANC	16665
Andenes	Nordland	Norway	21660		43120
Arctic Bay	Nunavut	Canada		CAARB	
Arkhangelsk	Arkhangelsk Oblast	Russia	62800	RUARH	BA2280
Arviat	Nunavut	Canada		CAYEK	
Attu	East Coast	Greenland	700		38480
Aupaluk	Nunavik	Canada		CAYPJ	
Baker Lake	Nunavut	Canada		CABLK	
Ballangen	Nordland	Norway	22050	NOBLL	43144
Ballstad	Nordland	Norway	21840	NOBSD	43146
Barentsburg	Svalbard	Svalbard	20560	SJBAR	42052
Barrow	Arctic	US Alaska	20480	USBRW	16082
Bathurst Inlet	Nunavut	Canada		CABAT	
Belomorsk	Reupblic of Karelia	Russia	62830		BA2275

Showing 1 to 351 of 351 entries

*Opening screen for **Arctic Maritime***