Arctic Observing Summit
Theme 3: Involving Industry in Sustaining Arctic Observations
Synthesis Paper

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Introduction

Decreasing sea ice extent coupled with an increasing interest in natural resource development are driving increased private sector activity in the Arctic, including oil and gas, shipping, fishing, tourism, and mining - along with associated infrastructure development. There is a need for better Arctic information to support safe, responsible, and effective industry operations. This information could be provided by an Arctic observing system involving the research community, governments, and industry. In particular, there is a need and opportunity for industry data collection and sharing, e.g. in relation to the World Ocean Council program on "Smart Ocean-Smart Industries". This Arctic Observing Summit 2016 theme will address the following questions:

1. What information does industry need?
2. What data does, and can, industry collect and share?
3. What assets and resources can industry offer to help sustain Arctic observations?
4. What is the value proposition for industry?
5. How can cooperation between industry and the research community be best coordinated?
6. What are the impediments to cooperation?

The following sections provide a foundation for discussions during Theme 3 of the 2016 Arctic Observing Summit.

Context

The Arctic Observing Summit is occurring at a time of rapidly increasing interest in the Arctic with an associated need to provide integrated information to support the research and operations of a growing range of user communities, such as science, industry, government, and northern communities. A number of political, environmental, social, and technological trends are fueling this interest, including:

- Political and Policy Trends – The interest of governments around the world in the Arctic is driven by the perceived opportunities for economic development, more efficient shipping routes, and the regions' geo-political strategic and sovereignty importance. With these opportunities come concerns over their environmental impact and risks to life and property in a hostile environment where governments have a duty to mitigate risks through emergency response and search and rescue operations. The opportunities are also motivating countries to try to expand their jurisdictions and better protect their borders.
- Economic Trends – Economic development opportunities include development of renewable resources such as fisheries and forests; non-renewable resources such as fossil energy resources and minerals; and other activities such as shipping and tourism. Closely associated with these opportunities is the need for related infrastructure development, such as offshore platforms, ice class ships, pipelines, railways, roads, seaports, airports, and housing. There is also the potential for increased pollution and environmental accidents.
- Social and Cultural Trends – Concern about the impact of climate change is growing around the world and it is becoming evident that the impact is greatest in the Arctic. Of particular social relevance in the Arctic are the changes that are being imposed on Indigenous Peoples by climate change and increased economic activity. Such changes include impacts on hunting and fishing practices, impacts on infrastructure caused by coastal erosion and the melting of permafrost, and impacts on culture and social cohesion.
- Technological Trends – A number of technological trends are providing a flood of new data concerning the Arctic. Of particular relevance are space-based technologies such as earth observation, satellite telecommunications, global navigation satellite systems (GNSS), and automatic identification systems (AIS). Each has a role to play in monitoring the vast and harsh Arctic and each is undergoing significant improvements in capabilities. There is also increasing attention being given to in-situ data networks and socio-economic data. Behind the data are new data infrastructure and data standards that support data collection, discovery, integration, and analysis.

Industry's Arctic Data Requirements

The requirements for information in the Arctic are being driven by a broad range of scientific, operational, and societal imperatives. Researchers are involved in a host of studies on changes taking place across many domains, including climate, oceans, atmosphere, and ecosystems, which have significant impacts in the regions and, through complex earth system connections, worldwide. The drivers include both national and international science policies, strategies, and programmes that contribute to an understanding of the changes taking place in the Arctic and shape policy responses.

Operations in the Arctic take place in some of the most difficult conditions on Earth. Those involved in these operations, such as tourism, shipping and fisheries companies, offshore oil and gas operators, research organizations, coast guards, and local communities, require access to reliable and often near real-time information to plan and undertake their activities. Drivers of information requirements include a range of regulations, standards, and policies (such as the new Polar Code[1]) aimed at ensuring safety of life and mitigating negative environmental impacts.

Many responsible companies care about the Arctic and are in fact working to address their environmental footprint. These companies realize that addressing sustainability, science, and stewardship is not only important to the future of the Arctic, but to the future of their business. However, while supportive of Arctic science, industry data needs are driven by operational imperatives.

A number of exercises have looked at the Arctic information requirements of industry. For example, the Sea Ice Prediction Network (SPIN) project is consulting with key industry stakeholders to understand what sea ice information and forecasts are needed to inform decisions[2] and the Polaris initiative of the European Space Agency has undertaken a broad analysis of user needs and high-level requirements for the next generation of observing systems for the polar regions. Table 1 provides some examples of industry activities that require Arctic data.

Table 1: Examples of Polar Operational Activities that Drive Information Requirements

Theme	Examples of Types of Activities
Environmental Impact Assessment	▪ Supporting the responsible development of major infrastructure or resource development projects ▪ Assessing and mitigating the operation of such projects
Engineering Design	▪ Design of buildings and structures for installation in changing permafrost conditions ▪ Design of offshore drilling and production platforms for safe and effective deployment in ice-covered waters
Safe Navigation and Operations	▪ Navigation of vessels through hazardous ice-covered waters ▪ Avoiding collisions with icebergs in operation of offshore oil and gas exploration and production platforms ▪ Navigation to and along the sea ice edge for traditional hunting and fishing
Risk Management	▪ Assessing the risks of subsidence around buildings, pipelines and structures in permafrost areas

[1] To help address the risks of operating in the polar regions, the International Maritime Organization (IMO) Marine Environment Protection Committee approved the "Draft International Code for Ships Operating in Polar Waters" (known as the Polar Code) on 21 January, 2015. It will take effect on 1 January, 2017.

[2] Tivy, A.; Petrich, C. (2016) Observations to support industry needs for sea ice information and predictions; Arctic Observing Summit 2016 White Paper.

	▪ Assessing and mitigating the risks of flooding due to ice-jammed rivers
Emergency Response	▪ Developing and maintaining a common operating picture (COP) between response organizations ▪ Expeditious movement of responders and their equipment from bases of operation to the emergency site
Weather Forecasting	▪ Observing and modelling weather patterns to improve short-term weather predictions in support of operations in the polar regions
Climate Change Adaptation	▪ Establishing new regulations and standards, investing in new infrastructure, and enhancing operational capabilities in reaction to changes in the polar climate and its impact on southern latitudes

Industry's Involvement in the Arctic Data Community

The Arctic data community consists of a wide variety of data producers, managers, and users in government, industry, and academia that need data for scientific research and to support operations in the Arctic. Not surprisingly, there is a large degree of overlap among both the organizations and people involved in these activities.

The Arctic data community has made efforts to collectively address the efficient and effective acquisition and management of Arctic data. While industry often provides "feedback to operational service providers on the operational usability, as well as on the need for further improvement of development"[3], to date, industry's involvement has been primarily as a consumer of data and their contribution to the collection and stewardship of Arctic data has been minimal.

However, there are a few examples of industry involvement in environmental data collection that can provide lessons and inspiration for the development of a program in the Arctic:

- The World Ocean Council (WOC) has launched the "Smart Ocean-Smart Industries" (SO-SI) Program as a major new initiative to catalyze ocean industry leadership in contributing to the long-term science, understanding, health, and management of the ocean. The SO-SI Program is facilitating ocean industry efforts to collect and share data that: a) contributes to describing the status, trends and variability of ocean, weather and climate; and b) improves the understanding, modeling, forecasting, monitoring and management of ocean ecosystems, resources, weather and climate. The program will ensure that voluntary observation efforts by shipping, oil/gas, fisheries, offshore renewable energy and other ocean industries is coordinated, efficient, cost effective and is integrated into national and

[3] Eltoft, T.; et al. (2016) *CIRFA – Centre for Integrated Remote Sensing and Forecasting for Arctic Operations, a new centre for research-based innovation hosted by UiT – The Arctic University of Norway*; Arctic Observing Summit 2016 White Paper.

international observation programs. The unique multi-sectoral basis of the program creates significant opportunities for synergies and economies of scale, e.g. in sensor development.

- Visual observations of ice from airplane or ship are an integral part of sea ice monitoring for operational and research support. These observations provide information about sea ice morphology that is not obtainable or ambiguous in remotely sensed data. The Ice Watch program provides observation protocols and software to aid in the standardization of ship-based visual sea ice observations in the Northern hemisphere and globally. While the coverage of Ice Watch data is limited to one nautical mile along ship tracks, it does provide a richer data set than is possible with remote sensing alone.[4]

- The Ship Observations Team (SOT) of the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) coordinate a number of programs. National agencies and institutions implement and operate the JCOMM programs at the national level. The programs are:

  - The Ship-of-Opportunity Program (SOOP)
  - The Voluntary Observing Ship (VOS) program
  - The VOS Climate Project (VOSClim) program
  - The Automated Shipboard Aerological Program (ASAP)

- Other programs include the Ferry Box program (ocean data collected by ferries in Europe), the SeaKeepers program (ocean data collected by mega-yachts), the Argo program, the efforts of the OceanScope working group of the Scientific Committee on Ocean Research (SCOR) and others. There have also been several projects by individual shipping lines and oil companies to collect data from vessels in partnership with specific government or scientific institutions, e.g. the Oleander Project.

All of these examples are from the marine sector and in the Arctic context; land-based programs will also need to be developed.

As a result of the existing programs, experience has been gained in understanding what it takes to engage companies in data collection, develop the working relationships between commercial and scientific entities, install and maintain instruments, train observers, and, ultimately, collect and report data. Infrastructure operators have been receptive to supporting observation instrumentation. They see this as providing a service that provides feedback for their own benefit and only they require that the equipment makes no, or minimal, demands on costs, insurance, time, people or operations.

[4] Hutchings, J.; et al. (2016) *Ice Watch: Standardizing and expanding Arctic ship based sea ice observations*; Arctic Observing Summit 2016 White Paper.

Unfortunately, there are limitations to these programs. There have been significant difficulties in creating sustained, long term observations, e.g. due to companies being bought and sold, ships getting reassigned to different routes, lack of understanding and support at senior management levels for participation in voluntary observation programs, etc. Where there have been specific, one-off data collection partnerships between companies and scientific institutions, these often miss the opportunity to ensure the information can contribute to globally standardized data systems and analysis. On a broader scale, the programs to date have mainly focused only on merchant ships, and on oil platforms to a limited extent, but have not included other kinds of infrastructure.

Still, expanding the scope and scale of ocean and atmosphere observations is essential to improved understanding, modeling, and predicting of the Arctic. This will in turn reduce risks to Arctic industries posed by changing conditions. Government and scientific institutions and budgets will not be expanding in the near term to fill this need. The presence of industry across the Arctic presents an opportunity to cost effectively scale up data collection and a compelling case for Arctic industries to expand their involvement in Arctic observations.

Such programs are a win-win for both industry and science. The business value of the program includes:

- Improved information for ocean condition observations, now-casts, forecasts and hind-casts;
- Improved predictability of, and reduced risk from, extreme events that impact ships and platforms;
- Improved weather information and resulting savings from ship routing, fuel efficiencies, etc.;
- Reputational benefits from contributing to ocean positive efforts to document and monitor the marine environment;
- Opportunities for educational and promotional outreach to stakeholders and the public;
- Increased leverage and opportunities to shape ocean science and policy;
- Participation in the development of emerging new observational technologies;
- Increased data on the physical and biological environment in which commercial activities are taking place;
- Standardized data on environmental conditions and impacts, e.g. air and water emissions;
- Data-driven input to corporate policies and practices;
- An increased and improved science basis for interaction with stakeholders on Arctic environmental issues.

The program's benefits to science include:

- The ability to collect oceanic and atmospheric data on a significantly expanded spatial and temporal scale;

- The collection of data over longer time series and/or along repeated routes;
- The observation of ocean and atmosphere conditions in ways and places impossible to get by other means;
- The opportunity to fills major gaps in data and understanding;
- A highly cost effective means of data collection;
- Increasing the global scope, scale and perspective of ocean data and understanding;
- Improving and expanding the partnership and common ground between science, government and industry.

Fostering Data Collection and Sharing by Industry

While the need to better understand, model, and monitor the Arctic in support of responsible economic use, conservation, and management has never been greater, government and scientific institutions have fewer resources to collect data. Shipping, oil and gas, mining, and other Arctic industries operate infrastructure with tremendous potential for cost effectively collecting data, often in areas important to filling science gaps. Piecemeal efforts to date have put instruments on 'ships of opportunity' and yielded important data and experience, but these have been limited in numbers of vessels, area covered, and timespan due to the lack of an overall system to foster, plan and coordinate the efforts.

The opportunities for Arctic observing by tourism operators have been particularly noted. "Ship, airplane, and land-based Arctic tourism regularly brings observational capacity into settings that may remain otherwise unobservable, but scientists have not fully capitalized on this opportunity to date." "While the need to monitor Arctic tourism's impacts is widely accepted, ways in which tourism can play a positive role in Arctic Observing Systems have so far not been explored nor highlighted sufficiently." "Tourism is ... already contributing to [Arctic observing systems], but efforts are dispersed over space and time, and uncoordinated across regions and scientific disciplines."[5]

Establishing a program for data collection and sharing by industry will require leadership by responsible Arctic business and collaboration with existing national and international organizations that collect, transmit, store and analyze Arctic information. The Arctic Observing Summit can provide a forum to initiate the discussions among industry and the science community towards creating a structure and process to foster, facilitate, and coordinate industry participants that are willing to collect data.

The strategy for such a program might consist of the following components:

[5] Hillmer-Pegram, K.; et al. (2016) *Arctic Tourism Should be used as a Vehicle for Arctic Observing Systems*; Arctic Observing Summit 2016 White Paper.

- **Vision**: Companies from a range of industries are engaged in the systematic, regular, sustained, and integrated collecting and reporting of standardized Arctic data that contribute to Arctic science and improving the safety and sustainability of commercial activities in the Arctic.

- **Goal**: To establish a program platform that fosters, facilitates and coordinates efficient, cost-effective efforts by Arctic industry in the collection and sharing of Arctic environmental data.

- **Outputs**: A significant increase in the kind and amount of data, resulting from industry partnerships with the scientific community, governments, inter-governmental agencies and other key Arctic stakeholders.

- **Outcomes**: Substantially improved understanding, monitoring, modeling, forecasting, and management of the Arctic and a new era of industry collaboration with the scientific community, governments, inter-governmental agencies and other key Arctic stakeholders.

There are a number of considerations to be addressed in developing the details of such a program, including human capacity, resource needs, installation requirements, organizational structures, legal issues, etc. Some of these are listed below.

Networking, Integration and Institutional Relationships

- Frameworks for collaboration between industry and the marine research community
- Frameworks for collaboration among companies and between industry sectors
- Integration with existing Arctic observing programs
- Standardization of policies and procedures

Scientific Program Requirements

- Scientific needs for Arctic observation parameters
- Preferred locations for observations
- Development and implementation of observational programs
- Maintaining appropriate inventories, monitoring reports and analyses, and information exchange facilities

Platforms

- Industries and kinds of activities/facilities appropriate for observation programs
- Infrastructure types suitable for sustained observation efforts

Technology and Instrumentation

- Technologies that can enhance vessel or platform capability for ocean observations

- Priority instrument needs to meet future requirements
- Coordinating implementation of specialized shipboard instrumentation and observing practices
- Exchange of technical information on equipment and expendables, development, functionality, reliability and accuracy

Communications Procedures, Hardware, and Software

- Employ standardized procedures, technologies, and instrumentation
- Information and advisory links with the scientific and government communities
- Managing communications, data transfer, distribution, handling, and archiving
- Hardware reliability and software robustness to provide unattended operation over periods of months to years
- Ensuring transmission of low resolution data in real time from participating ships; ensuring that delayed more high resolution data are checked and distributed in a timely manner to data processing centres
- Data issues, including data ownership, release and sharing