# Platform outcome measurement study

## Expert panel report

### CANADIAN RESEARCH ICEBREAKER CCGS *AMUNDSEN*

**November 11-12, 2014**

INNOVATION.CA
CANADA FOUNDATION FOR INNOVATION | FONDATION CANADIENNE POUR L'INNOVATION

# Contents

# Lexicon

| Acronyms used in the report | |
|---|---|
| *Amundsen* | Canadian Research Icebreaker CCGS *Amundsen* |
| ASDC | *Amundsen* Scientific Deployment Committee |
| BREA | Beaufort Regional Environmental Assessment |
| CASES | Canadian Arctic Shelf Exchange Study |
| CCG | Canadian Coast Guard |
| CCGS | Canadian Coast Guard Ship |
| CERC | Canada Excellence Research Chairs |
| CFI | Canada Foundation for Innovation |
| CFREF | Canada First Research Excellence Fund |
| CRC | Canada Research Chairs |
| EP | Expert Panel |
| EU | European Union |
| HQP | highly qualified personnel |
| IJVF | CFI International Joint Venture Fund |
| IRIS | Integrated Regional Impact Study |
| KTT | Knowledge translation and transfer |
| NCE | Network of Centres of Excellence |
| O & M | Operating and Maintenance |
| PDFs | Post-doctoral fellows |
| POMS | Platform outcome measurement study |
| SBDA | science-based departments and agencies |
| UK | United Kingdom |
| USA | United States of America |

# Platform outcome measurement study (POMS)

The Canada Foundation for Innovation (CFI) is grateful for the support and participation of the Canadian Research Icebreaker CCGS *Amundsen* team in the POMS and also wishes to thank the Expert Panel (EP) members for their time, expertise and many contributions to this report.

In November 2014, the CFI assembled a panel of experts to assess the activities and achievements of the *Amundsen* research platform and evaluate the degree to which the investment of the CFI and funding partners has had a transformative impact on Canada's research landscape and is contributing to the CFI's meeting its objectives.

The assessment was carried out as a POMS, one of CFI's suite of evaluation tools which was developed specifically for large-scale, specialized or multi-purpose research infrastructure that supports the Canadian research community.

An in-depth report prepared by the *Amundsen* team captured, with numbers and narrative, the outcomes and impacts of the platform. This confidential self-report (referred to herein as the *Amundsen* report), which also highlighted key organizational dimensions (e.g. governance, management, human resources), was provided to the EP. A visit by the group of experts allowed the members to gain additional insights about the activities and outcomes of the *Amundsen* and how they relate to each other. On the basis of the self-report and visit discussions, the EP assessed indicators of progress and outcomes (generally using a scale: high, medium or low), provided rationale for its decisions, and highlighted key contributions and impacts of the *Amundsen*.

This report summarizes the assessment, findings and conclusions of the EP.

## Members of the EP

**Martin Taylor (Chair)**
Professor Emeritus
University of Victoria, CANADA

**Carin Ashjian**
Senior Scientist, Department of Biology
Woods Hole Oceanographic Institution, USA

**Larry Mayer**
Professor, School of Marine Science and Ocean Engineering
Director, Center for Coastal and Ocean Mapping/NOAA-UNH Joint Hydrographic Center
University of New Hampshire, USA

**Michael Meredith**
Deputy Director of Science
British Antarctic Survey, UNITED KINGDOM

The CFI would like to acknowledge the participation of the following representatives of the Canadian Research Icebreaker CCGS *Amundsen* at the EP visit:

**Louis Fortier**
Project Leader, CCGS *Amundsen*
Scientific Director, ArcticNet
Professor and Canada Research Chair on the Response of Arctic Marine Ecosystems to Climate Change
Université Laval

**David Barber**
Associate Dean (Research), Faculty of Environment, Earth, and Resources
Professor and Canada Research Chair in Arctic System Science
University of Manitoba

**Michael Byers**
Professor and Canada Research Chair in Global Politics and International Law
The University of British Columbia

**Patrick Lajeunesse**
Professor, Department of Geography
Director, Laboratoire de géosciences marines
Université Laval

**Katie Blasco**
Communications Officer
ArcticNet

**Colline Gombault**
Administrative and Data Coordinator CCGS *Amundsen*
ArcticNet

**Keith Lévesque**
Marine Research Manager
ArcticNet

The CFI and the *Amundsen* team would like to express their gratitude and appreciation to the Canadian Coast Guard, notably Johnny Leclair, Regional Director, Central and Arctic Region, and Alain Gariépy, Commanding Officer, CCGS *Amundsen*, for hosting part of the Expert panel meeting on the ship. The CFI would also like to thank Université Laval for their support and participation as well as all observers who attended the meeting.

# Key findings

The *Amundsen* platform is enabling science of the highest international quality and is facilitating the translation and application of new knowledge to address societal issues of major consequence for the Arctic regions of Canada and for other Arctic settings.

- The nature and scope of the *Amundsen's* scientific and technical capabilities are impressive and internationally competitive when compared with the Arctic research vessels operating in the United States (USA), United Kingdom (UK) and European Union (EU).
- The *Amundsen* has had a profound effect on the capacity of Canadian researchers (and of Canada) to lead and conduct internationally competitive research in the Arctic which, prior to the recommissioning and retrofit of the vessel, was at risk of serious decline.

The *Amundsen* research program has had a major impact on the productivity, reach and influence of Canadian Arctic science as shown by the strong publication record and by the seminal papers produced on such topics as sea ice and ecological research in the Beaufort Sea.

- The breadth of science supported by the platform is impressive, especially given the complexities of accommodating diverse perspectives and needs of cross discipline, institution and sector collaborations.
- The platform has had a major impact on the international visibility and reputation of Canadian Arctic science. The engagement of Canada Research Chairs (CRCs) and Canada Excellence Research Chairs (CERCs) speaks to the *Amundsen*'s international leadership and competitiveness as does the forging of international partnerships.
- The *Amundsen* is making an important contribution to the training of an emerging new generation of Arctic scientists for careers in academia, government and industry.

The *Amundsen* program has engaged a diverse set of end-users encompassing federal and provincial science-based government departments and agencies, industry, and communities.

- Innovative and effective methods for disseminating research results have been developed: the Integrated Regional Impact Study (IRIS, developed in close partnership with ArcticNet), bathymetric data for charting purposes including boundary determination, and community health surveys are signal examples.

*Amundsen* senior management is to be commended for its identification of main challenges facing the future operation and vitality of the platform: strengthening governance structures and processes; meeting substantial annual operating costs; planning for the impact of the sunset of the ArcticNet Network of Centres of Excellence (NCE) in 2018; upgrading the pool of scientific equipment; and recruiting and retaining highly qualified technical staff.

The CFI has and continues to be the sine qua non for creating and sustaining the *Amundsen* platform. The CFI funding investments are impressive and have leveraged substantial support from provincial and industrial partners. Federal funding agencies and their partners should continue to provide and sustain competitive funding mechanisms whereby this remarkable asset can continue to flourish and thereby enhance its high-quality and high-impact Arctic research for Canadian science and society.

# 1. Overview of the research platform

## 1.1 High-level description of the research platform

The research platform consists of the Canadian Coast Guard (CCG) icebreaker *Amundsen* and its pool of specialized scientific equipment and facilities. This comprehensive pool of research infrastructure, which remains unmatched by any other Canadian research ship, provides unique technical capabilities that can satisfy the diverse interests and most specialized needs of its users. From 2003 to 2014, the research platform supported science initiatives in the Arctic for 11 seasons (in 2012, the ship was out of commission for the replacement of its engines). During that period, the *Amundsen* provided unprecedented access to the Canadian Arctic and its communities for Canadian and foreign researchers who spent an average of 149 days at sea per season including two overwinterings. In total, users of the research platform have thus far logged 59,025 person-days at sea on the *Amundsen*.

The research platform was made possible after a consortium of 15 Canadian universities and research centres, in partnership with the federal government, received funding from the CFI for the retrofit of the decommissioned Canadian Coast Guard Icebreaker *Sir John Franklin* as an Arctic Ocean research vessel. This contribution of $27.5 million from the CFI International Joint Venture Fund (IJVF) included nearly $19.4 million for structural transformations to the ship for science, and for scientific equipment as well as $5.5 million in support for the operations of the platform. After an eight-month overhaul, the revamped icebreaker, rechristened CCGS *Amundsen* in honour of Norwegian explorer Roald Amundsen, was inaugurated on August 26, 2003.

After this initial investment, the equipment pool of the platform continued to be enhanced (and recapitalized) through investments from granting agencies, stakeholders, and user programs; and it is now estimated to have risen to a value of $36.5 million (before depreciation). The CFI has contributed to upgrading and expanding the scientific equipment of the icebreaker *Amundsen* through several individual awards to Canadian researchers, but most significantly through a Leading Edge Fund contribution of $10.9 million in 2006 (40 percent of which came from the CFI along with matching funds of $4.3 million from the Quebec and Manitoba governments).

The CCGS *Amundsen* is based in Quebec City. It is one of the few CCG vessels to have a dual purpose. As part of the agreement with the consortium of Canadian universities and research centres, the CCG maintains the infrastructure operational and available for science for up to 152 days of operations per year. The vessel is crewed by the CCG which uses the ship for icebreaking operations in the winter, after which it is free for research assignments. From mid-

May to mid-November, the *Amundsen* can be chartered by the scientific community to make its way to the Canadian Arctic to support a wide variety of scientific missions. Special arrangements can also be negotiated with the CCG to extend the availability of the CCGS *Amundsen* in a given year to accommodate circum-annual science programs in the Arctic.

The *Amundsen* and its equipment form the core infrastructure for supporting several national and international programs including the large ocean-based component of ArcticNet, a NCE created in 2003 that brings together over 140 scientists in the natural, human health and social sciences from across Canada with their partners in northern communities, governments, and industry to study the Arctic.

Université Laval (Quebec City, Que.) serves as the project's host for both the *Amundsen* research platform and the ArcticNet NCE. The consortium of Canadian universities led by Université Laval delegates most of the management and operational activities of the *Amundsen* research platform to ArcticNet. The management, deployment, maintenance and troubleshooting on land and at sea of the *Amundsen*'s overall pool of collective equipment is under the responsibility of a small team of 14 managers, engineers and technicians.

The ship is available for science on a full cost-recovery basis. The consortium and its scientific partners secure the funds to cover the large operation costs of the ship ($57,500 per day in 2014). These costs encompass the salaries of the crew (two complements of 38 CCG crew operate the *Amundsen* while at sea, alternating on six-week rotations), fuel and lubricants, air travel for the exchange of personnel, and food and supplies. In all, the annual operating budget for the 152 days available for science is currently estimated at $10.8 million including the maintenance of the equipment pool and the administration of the platform.

## 1.2 Governance, management and advisory structures

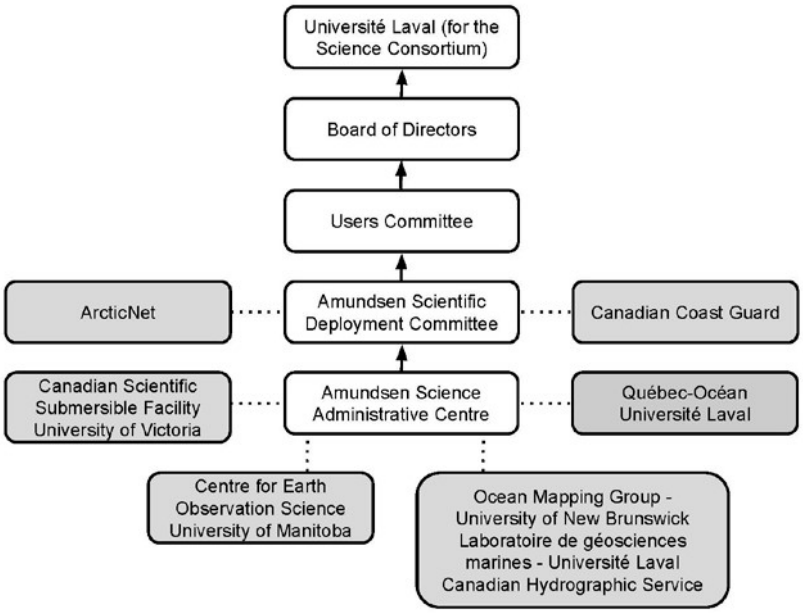
The EP noted the strong linkage between the *Amundsen* program and the ArcticNet NCE for both governance and management structures and functions. As the *Amundsen* report states "the *Amundsen* is a core infrastructure of the ArcticNet NCE, which provides continuity in operation funding and substantial support for the management of the platform. Accordingly, the Board of Directors of ArcticNet plays a significant advisory role in overseeing the platform through the cross-appointment of two Directors with the Board of the *Amundsen*."

Governance of the platform itself is vested with a Board of Directors with six members currently drawn from academia, government and the private sector. The Board provides information and/or recommendations to the host university, Université Laval, the lead institution for the Science Consortium of 15 universities who were signatories to the CFI IJVF application in 2002.

At the management level, the *Amundsen* Science Administrative Centre, reporting to the *Amundsen* Scientific Deployment Committee (ASDC), which in turn reports to the Board, plays a central role in managing the equipment pool, coordinating efforts among the research units involved in the maintenance of the equipment, and liaising with the Canadian Scientific Submersible Facility (see Figure 1). The Users Committee, which brings together the scientific users, CCG and all interested parties, meets annually with the ASDC to coordinate science operations among the different programs, to define the schedule of the ship, and to plan

mobilization. The Science Administrative Centre and the two committees report to the Board of Directors through the Scientific Leader.

Figure 1 *Amundsen* management structure and committees




Note: Full line: reports to; dashed line: provides information and/or recommendations to.

Source: *Amundsen* report to the EP

Key to risk sharing and liability is the fact that the CCG manages and maintains the icebreaker itself and hosts it at its Quebec City base. The Science Consortium is responsible for securing operational funds, coordinating operations at sea, and for the maintenance and deployment of the scientific equipment. The linkages between the platform, Université Laval and the CCG are defined in a cost sharing arrangement. Université Laval, through the offices of ArcticNet, coordinates demands for the platform from different users (academic, private sector, international), manages the flow of operation funds, supervises the maintenance of the scientific equipment, and prepares the annual schedule of deployment of the icebreaker.

The panel had some difficulty understanding the governance and management structures and the interplay between the *Amundsen* and ArcticNet programs. It was also not obvious how Université Laval functioned with/for the Science Consortium of 15 universities and how the interest of the other universities (with the exception of the University of Manitoba) were voiced or heard at the board or management levels. Moreover, the interpretation of the reporting relationships between the various organizational elements was not entirely transparent. Probably for good reason, the *Amundsen* platform, as the enabling infrastructure, depended heavily on ArcticNet, as the primary source of operations and research funding, to provide core governance and management functions.

The panel accepted the argument of the *Amundsen* team that the arrangements had worked effectively and efficiently to date and had avoided administrative over-burden both in

governance and management. The argument was compelling and convincing given the impressive record of successful science missions already completed over the first decade of the *Amundsen* program. It, however, left unanswered questions regarding the way forward and sustainability in the longer term, particularly beyond the current sunset of the ArcticNet program in 2018, given the expected life of the *Amundsen* for at least another decade beyond that.

The possibility of incorporating the *Amundsen* as a not-for-profit entity is currently being considered, thereby creating a more robust governance structure for the longer term. The panel saw this as an appropriate evolution in the life cycle of the platform, and consistent with the additional fiscal and other responsibilities likely to be vested with the Board in the future. Such a development would need to address the appropriate size, composition and core competencies of the Board which the panel questioned as currently constituted. Embedded in this enlarged governance function is fulfilling the legitimate aspiration of the *Amundsen* program to meet the expectations associated with the operation of a national facility, and one that is regarded as internationally competitive in the arena of global ocean science.

In terms of scientific management, the EP questioned the openness of access to the *Amundsen* for a broad research community of Canadian and international scientists. Here again the interplay with the ArcticNet program seemed possibly double-edged: while serving to define a highly talented, motivated and funded pool of researchers, ease of access for non-ArcticNet scientists remained unclear. The team provided some reassurance to the panel while acknowledging that routes and rules of entry were more complicated for those outside of the ArcticNet community.

## 1.3 Platform planning process

| | |
|---|---|
| EP rating of the quality and effectiveness of the planning and performance monitoring processes to achieve platform's short- and long-term objectives | **Medium** |

Two main plans guide the supervision, management and operation of the platform: the strategic plan and the equipment management plan. Progress towards achieving the objectives of the strategic plan is measured by specific metrics. The objectives listed in the *Amundsen* report are:

- To maximize days at sea in support of Canadian-led international Arctic science;
- To coordinate operations at sea among the different user programs;
- To develop the community of Canadian users;
- To facilitate international participation in the platform;
- To foster research collaborations with the private sector;
- To continuously improve the safety of operations at sea and on the ice;
- To explore new avenues for the funding of operations at sea and equipment maintenance;
- To recapitalize existing equipment and to expand the equipment pool with new technologies; and,
- To implement the communications and outreach plan including the Schools on Board program and the production of an annual report.

The equipment management plan "aims to maximize the scientific return of operations at sea by maintaining the equipment pool in optimal condition and continuously improving technical support at sea" with indicators again defined to monitor performance. The *Amundsen* report notes the success of efforts made since 2012 "to improve the corporate culture of the platform and [foster] a feeling of belonging to the organization."

The following table provides a useful summary of the roles of various elements within the organization in the planning processes.

Table 1 Roles of various individuals, groups and organizations in the planning process

| Element | Role |
|---|---|
| *Amundsen* Board of Directors | Annually discusses and approves the strategic plan and equipment management plan and oversees their implementation. Approves the annual deployment schedule. |
| *Amundsen* Scientific Leader | Based on input from stakeholders and users, continuously amends the strategic plan, proposing the main avenues of development and funding of the platform. Leads the implementation of the equipment management plan with support from the Marine Research Manager. |
| Science Administrative Centre | Implements the strategic plan, the equipment management plan and prepares the annual deployment schedule. |
| Academic research users | Develop new research programs using the platform that contribute to the Canadian and international effort in the study of the Arctic Ocean. Continuously inform the equipment management plan with their needs and suggestions. Contribute to the strategic plan with, for instance, ideas for international collaborations and partnerships with the private sector. |
| Government-based research users | Typically, participate in the planning and deployment of academia-led research programs as members of research teams. Mainly from the Departments of Fisheries and Oceans Canada, Environment Canada, and Natural Resources Canada. |
| Private-sector research users and stakeholders | Private-sector research users jointly plan collaborations with the academic sector to answer their research needs and contribute to the development of the equipment pool and to improve safety on board the icebreaker. Some consulting companies participate as team members in the planning and implementation of academia-led proposals. |
| Academic stakeholders | Université Laval, University of Manitoba, University of New Brunswick and University of Victoria are the main academic stakeholders responsible for the management, maintenance and deployment of the scientific equipment of the platform. |

| | |
|---|---|
| Canadian Coast Guard | Participates in the planning and costing of operations at sea. Provides logistical expertise for deployment of the platform and technical expertise for the adaptation of science systems to the ship. Manages, maintains and modernizes the icebreaker. |
| Visitors | Invited participants (high school students, media, diplomats, elected representatives, artists etc.) in *Amundsen* Arctic expeditions contribute to the mission planning process and to the communications and outreach plan. |

Source: *Amundsen* report to the EP

The *Amundsen* report also identifies major external influences on the strategic and equipment management plans and on the scientific program of the platform: ArcticNet, the International Polar Year, offshore exploration for petroleum in the Beaufort Sea, the Canada Excellence Research Chairs program, international programs, and various federal initiatives. Similarly, new collaborations with the private sector, and international initiatives such as France's Chantier Arctique, and Europe's Horizon 2020 are expected to affect the future missions of the *Amundsen*.

While the strategic and management plans have been largely effective to date, the *medium* rating reflected the EP's opinion that questions about the coherence and effectiveness of planning processes for the longer term were not fully answered either in the *Amundsen* report or at the site visit.

Issues identified by the panel echo some of those previously noted for governance and management, specifically the terms of reference for, and reporting relationships among, the organizational bodies having responsibilities for planning functions. Issues remaining for the panel included: integration of the strategic and equipment management plans; research/cruise priority-setting processes including pre-cruise planning and post-cruise reporting; decision-making responsibility for capital investments; opportunities for the participation of non-ArcticNet scientists; proactive engagement of international scientists (especially for the longer term); progress achieved based on trends in the metrics; and, while beyond the authority or responsibility of the *Amundsen*, Board and management strategies for addressing the challenge in the Canadian system of the absence of statutory operating and maintenance (O & M) funding.

# 2. Research capacity

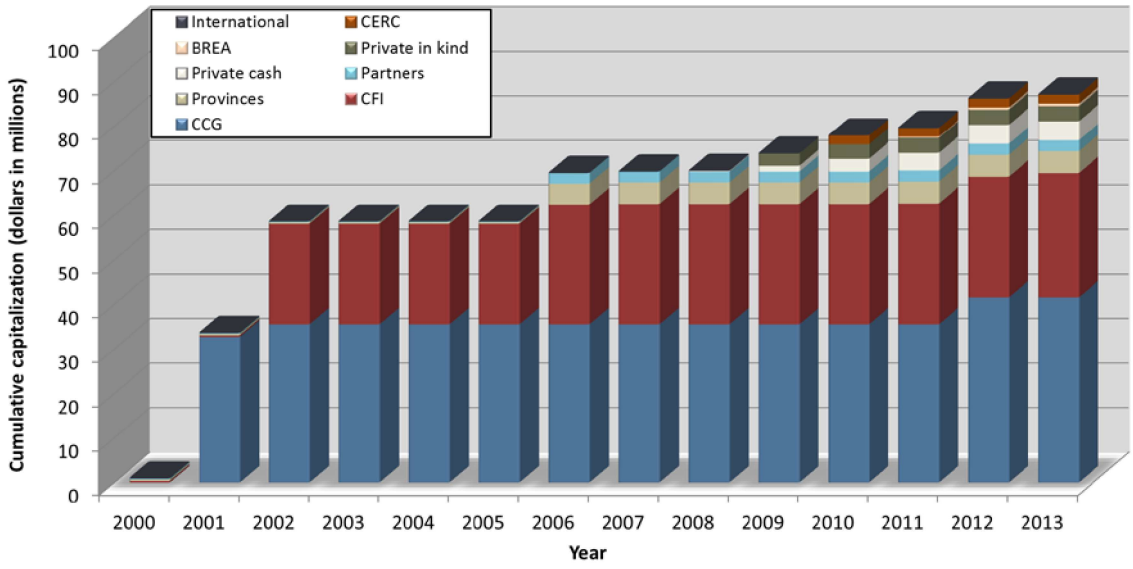
***"The capabilities of the platform are impressive, and match those of virtually any other research icebreaker globally."* — EP member**

## 2.1 Platform development and sustainability

| | |
|---|---|
| EP rating of the current nature and scope of platform capabilities (including infrastructure, personnel competencies, service functions) | **High** |
| EP rating of the adequacy of the platform enhancements since the base year in order to keep offerings competitive | **High** |
| EP rating of the overall approaches to sustainability of the platform and its related services | **Medium** |

As described in the *Amundsen* report, the platform infrastructure consists of the ship itself with its technically advanced navigational capacities, plus a comprehensive pool of scientific instrumentation and facilities valued at over $36.5 million. The ship's rebuild/retrofit and the pool of scientific equipment accommodate the needs of a broad and multi-disciplinary research community that includes physical, chemical, and biological oceanographers, paleo-oceanographers, marine geologists and geophysicists, marine ecologists, atmospheric scientists, ocean colour specialists, and epidemiologists studying Inuit health. Overall, the *Amundsen* is now equipped with 65 scientific systems divided into seven major components. Figure 2 summarizes the record of cumulative capitalization of the platform by sources and years.

Figure 2 Evolution of the cumulative capital value of the platform by sources (*Amundsen* icebreaker and scientific equipment pool)




Source: *Amundsen* report to the EP

The scope of the platform's capabilities is convincingly shown by the record of projects conducted: "among 18 major Canadian-led national and international efforts conducted by 106 teams since 2003, the platform has spearheaded the Canadian Arctic Shelf Exchange Study (CASES), the Inuit Health Surveys, the marine program of the ArcticNet NCE, the Canadian International Polar Year program, and major research collaborations with the Oil Exploration sector in the Beaufort Sea." Moreover, the *Amundsen* program supports all four pillars of Canada's Northern Strategy: Arctic sovereignty, economic development, the protection of ecosystems, and the devolution of governance. By so doing, the claim is fully justified that "its visibility in the media and the numerous benefits the platform brings to Canadian societies, north and south, have made the *Amundsen* the symbol of the recently renewed awareness of Canada to its Arctic dimension."

This impressive performance of sustained activity, output and contribution to advancing Canada's Arctic research has been enabled by strategic and opportunistic investments to refresh and enhance the infrastructure capabilities of the platform by successful funding applications, especially to CFI, beyond the initial IJVF award (on average $3 million per year in upgrades since 2006). Linked to the previous comments on planning processes, these investments reflect strong input from the user community, including the private sector, to maintain the capabilities of the platform as state-of-the-art at the international level.

It follows that the EP members were impressed by the nature and scope of the platform's capabilities in comparing the *Amundsen* with the Arctic research vessels with which they are familiar in the USA, the UK and the EU, and unequivocally rated that capability as *high.* They commented particularly on the platform's unique scope, diversity and scientific capability of the equipment, on its internationally competitive tool kit, and the resulting ability to support multi-disciplinary research.

They also recognized that this hardware capability was underpinned by a commitment to high maintenance standards and equipment reliability which, in turn, were dependent on the recruitment and retention of highly qualified and dedicated technical staff and an equally talented and motivated vessel crew. Also important here was the record of appointing highly qualified chief scientists to lead research cruises. These individuals combined the essential skill of being equally adept in their interactions and communications with the technical support personnel and vessel crew as they were with their on-board scientific research colleagues.

The EP was also unanimous in rating the platform enhancements and its continued competitiveness as *high*, applauding the strategic and successful applications to CFI competitions, which have been augmented by more opportunistic private- and public-sector investments of mutual advantage.

Platform sustainability was a topic of substantial discussion at various stages of the EP review especially recognizing the challenge of meeting the escalation of O & M costs (For example, the operating costs of the *Amundsen* at sea during a scientific expedition have doubled in the last 10 years, from $29,000 per day in 2003 to almost $60,000 in 2014.). The bottom-line was that the panel agreed on an overall rating of *medium*. There are issues here that are systemic and structural within the Canadian funding environment that are beyond the control of the *Amundsen* Board and management. Accordingly, the EP commended the *Amundsen* team on its success

in securing O & M funding to date and on its application to the 2014 CFI Major Science Initiative (MSI) Special Competition[1] for substantial additional funding at least in the short(er) term.

On the other hand, the EP's *medium* rating reflected its view that there is a "structural flaw" in the Canadian funding system for O & M, compared with the situation in other national jurisdictions (USA, UK, and Germany) where policies are in place for statutory and sustained provision for O & M costs. In this context, the panel felt that the onus was on the *Amundsen* to be all the more entrepreneurial in order to tap diverse sources which might entail surrendering some level of ownership. Here again, there are echoes of previous comments on governance and management and what competencies are required and from whom in order to provide strategic and tactical guidance to address and meet these major challenges which seem likely to remain in the foreseeable future.

## 2.2 Structuring effects on the Canadian research ecosystem

| EP rating of the magnitude and value-add of the platform on the structure of the Canadian research ecosystem | **High** |
|---|---|

The EP rated the structuring effect on the Canadian research ecosystem as *high* recognizing that the *Amundsen* program has had a profound effect on the capacity of Canadian researchers (and of Canada) to lead and conduct internationally competitive research in the Arctic which, prior to the retrofit and recommissioning of the vessel, was at risk of rapid decline.

As the *Amundsen* report states, and as the site visit reinforced, the effect has been most strongly felt at Université Laval and the University of Manitoba, the two universities that together have given primary leadership for the broader Science Consortium of 15 universities. That the impact goes well beyond those two universities is confirmed by the fact that of the 44 ocean scientists listed as main beneficiaries of the platform, 28 are affiliated with 21 universities or organizations other than Université Laval and University of Manitoba. This broader reach is also supported by the distribution of scientist-days at sea by province of origin.

In line with the findings of the 2013 Council of Canadian Academies report titled *Ocean Science in Canada: Meeting the Challenge, Seizing the Opportunity*, the *Amundsen* program allows the study of complex multi-disciplinary issues that are high priorities on both the scientific and societal agendas, including climate change, natural resources development, Arctic sovereignty and security, and community health.

An especially powerful signal of success and structuring effect has been the recruitment of the six CRCs, two CERCs and two other chair holders whose research relies heavily on the platform. Without at all diminishing the quality and capacity of other researchers, this leadership

[1] In February 2014, the CFI issued a Call for Proposal for the Major Science Initiatives (MSI) Special Competition that will expand its support of the ongoing O & M needs of unique national research facilities. Funding decisions were made by the CFI Board of Directors at its November 2014 meeting and are expected to be announced in early 2015. For more information about the program: http://www.innovation.ca/en/OurFunds/CFIFunds/MajorScienceInitiativesMSI2014SpecialCompetition

cohort is impressive by any standards and underscores the unique capabilities and opportunities afforded by the *Amundsen* to conduct world-leading science.

An important aspect of the uniqueness of the opportunity is the unrivalled access and associated cost saving for Canadian Arctic scientists provided by the *Amundsen* recognizing the infrastructure required to operate in the harsh environment of the Arctic. It is therefore no exaggeration to conclude that the *Amundsen* is a *sine qua non* for sustaining the Canadian Arctic research community and indeed for it to thrive.

Another compelling feature of the *Amundsen* program has been the development of innovative dissemination methods and tools that are potentially transferable to other areas of scientific research activity, especially in the realm of environmental research and policy. The IRIS methodology is a principal case in point demonstrating the strengths of the multi-disciplinary nature that characterizes much of the research enabled by the *Amundsen*, and also the allied commitment to bridging the science and policy domains. The *Amundsen* also supports the wider dissemination of its research by making available raw data and meta-data through the Polar Data Catalogue, a public metadata and data repository for ArcticNet, the *Amundsen* and a growing number of Canadian and international research institutions, programs and organizations.

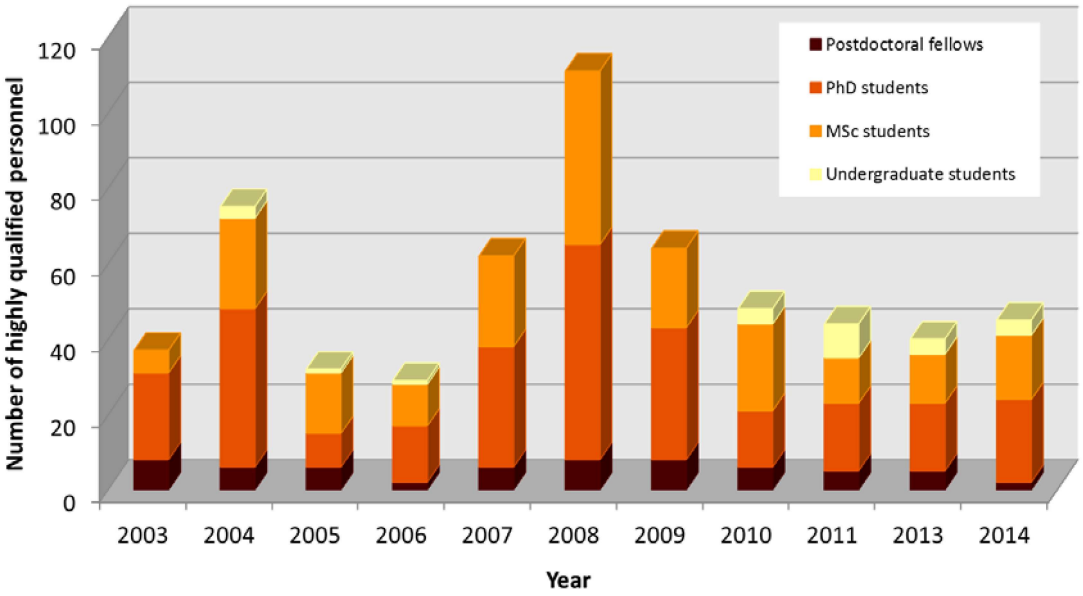
## 2.3 Contributions to the training of students and postdoctoral fellows

| | |
|---|---|
| EP rating of the impact of the platform on advancing the training of undergraduate and graduate students, and postdoctoral fellows since the base year | **High** |

The EP rated Highly Qualified Personnel (HQP) development as *high.* In quantitative terms, the *Amundsen* report identifies 46 research trainees in 2014 and a cumulative total of 417 trainees since 2003. The breakdown by year and HQP category is shown in Figure 3.

The HQP throughput and output shows considerable fluctuation annually (due in part to the varying length of annual expeditions) but is substantial overall. As such, the EP recognized the important contribution that the *Amundsen* is making to the training of an emerging new generation of Arctic scientists for careers in academia, government and industry, while recommending that a more systematic effort be made to track the career paths of *Amundsen* HQP. The quality of the training provided is as compelling as the numbers of HQP. The post-doctoral fellows (PDFs) and graduate students are typically supervised by top-class researchers and their experience on the *Amundsen* provides unique exposure and access to sophisticated equipment and so the opportunity to learn state-of-the-art technical skills in the course of advancing their research projects. Furthermore, they have the opportunity to undertake stimulating and challenging multi-disciplinary research aligned with their aspirations to conduct work that combines scientific discovery, methodological innovation and societal relevance. In these senses, the *Amundsen* is truly an exceptional laboratory for advanced research training at the frontiers of science for Canada and internationally.

Figure 3 Number of HQP trained on the *Amundsen* per year




Note that the icebreaker was out of commission in 2012.

Source: *Amundsen* report to the EP

While the focus here is on HQP development primarily at the level of PDFs and graduate students, the career advancement of more senior researchers is also of major consequence. This becomes all the more significant in light of succession planning for the next cadre of research leaders for the *Amundsen,* as the current principal investigators and chief scientists anticipate retirement. The policy in place to train new chief scientists on research cruises was seen by the EP as a very wise practice.

# 3. Research enabled

***"The platform has enabled Canadian science in the Arctic to attain a leading position; this science has been conducted by outstanding Canadian scientists, and it has drawn in international partners who seek to collaborate with them and share in the use of the platform."* — EP member**

## 3.1 Access and usage

| | |
|---|---|
| EP rating of the extent of utilization of the platform and its services in relation to capacity, demand and performance targets | **High** |
| EP rating of the extent to which the platform is accessible and used by a broad range of national and international users from diverse sectors | **Medium** |

Science operations are coordinated by the Users Committee reporting to the Board which has responsibility to resolve any priority and/or scheduling conflicts which to date have been relatively few. The Board sets the rules for the fee schedule which is graduated in relation to the category of user. In terms of utilization, the *Amundsen*'s annual target for science is set at 152 days at sea per year and from 2003 to 2011 this was exceeded with an average of 158.5 days. The annual breakdown of utilization by category of research user (see Table 2) shows considerable variability reflecting fluctuations in demand, especially related to the *Amundsen*'s support of major national and/or international programs, such as the Canadian Arctic Shelf Exchange Study (overwintering 2003-04) and the Canadian contribution to the International Polar Year (overwintering 2007-08).

The EP rating of *high* for platform utilization was supported by several factors that have contributed to the strong record to date. Canadian academic use has been driven by strong demand from the ArcticNet program, although the exact breakdown between ArcticNet and non-ArcticNet users was not reported. The EP noted the strength and diversity of utilization beyond the academic community. Seemingly effective, if somewhat *ad hoc,* policy and procedures are in place such that the *Amundsen* has met demand. However, it was unclear to the panel how sustainable these policies and procedures would be should future demand to conduct Arctic science increase. In the absence of sufficient data, the EP found it hard to assess utilization against expectations, or to compare it with usage rates for other international platforms. The EP identified the extent of multidisciplinary utilization as an unusual strength of the *Amundsen* program.

Table 2 Number of times per year research users (excluding HQP) boarded the *Amundsen* for work at sea, per category affiliation

| *Year* | *Canadian academic* | *Private sector* | *Government and not-for-profit* | *International academic* | *Annual total* |
|---|---|---|---|---|---|
| 2014 | 45 | 4 | 18 | 10 | 77 |
| 2013 | 30 | 5 | 11 | 0 | 46 |
| 2011 | 58 | 26 | 28 | 21 | 133 |
| 2010 | 47 | 26 | 31 | 4 | 108 |
| 2009 | 60 | 25 | 17 | 30 | 132 |
| 2008 | 103 | 4 | 46 | 65 | 218 |
| 2007 | 102 | 2 | 32 | 21 | 157 |
| 2006 | 38 | 1 | 30 | 6 | 75 |
| 2005 | 26 | 1 | 24 | 4 | 55 |
| 2004 | 94 | 2 | 29 | 23 | 147 |
| 2003 | 20 | 0 | 15 | 7 | 42 |
| **Total** | **623** | **96** | **281** | **191** | **1190** |
| **Total unique** | **452** | **60** | **199** | **176** | **890** |

Note that the "Total" includes participants that have come onboard multiple times throughout the years; "Total unique" represents the number of individual participants (no instances of duplication). In 2012, the vessel was out of service due to an engine refit.

Source: *Amundsen* report to the EP

The EP rated platform access for national and international use from diverse sectors as *medium*. The panel felt that there was scope for further growth of Canadian research utilization beyond the very strong involvement of researchers from ArcticNet. The EP also felt that opportunities for international researchers to access the platform are not well advertised or recognized, even though the *Amundsen* program is highly respected for the quality of its science, and that the procedures for international researchers to gain participation were unclear.

## 3.2 Linkages

| EP rating of the extent to which the platform has established and fostered collaborative relationships across disciplines, institutions and sectors | **High** |
|---|---|

The panel rating of *high* for cross-discipline, -institution and -sector collaboration reflects what was seen as a major and distinctive strength of the platform. The EP recognized the impressive breadth of science supported, especially given the complexities of accommodating diverse perspectives and needs. While it was difficult to disassociate attribution from what the ArcticNet program brings to the *Amundsen*, especially for institutional engagement, this is a minor point in retrospect, though of possible greater consequence after the projected end of the ArcticNet NCE in 2018. Each of the 18 major research programs supported by the *Amundsen* completed so far involved research networks bringing together teams from several universities and federal

departments to conduct multi-disciplinary Arctic Ocean research and to monitor the health of coastal communities.The EP was also impressed by the strong evidence of private-sector involvement and the apparent success of combining scientific and private-sector objectives to mutual advantage.

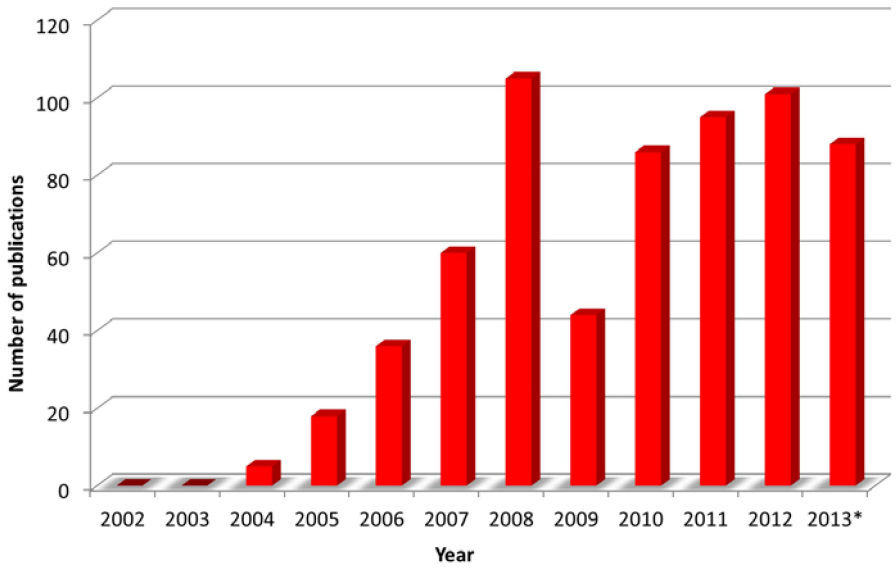
Further to the previous point, the *Amundsen* is under-utilized as far as international collaboration is concerned with the EP judging greater potential than has been realized so far.

## 3.3 Research contributions

| EP rating of the impact of the platform on the relevance, type, quantity and quality of research enabled | **High** |
|---|---|

In the words of the *Amundsen* report: "After 11 seasons of operation, the massive scientific and technological returns of the platform are clearly emerging. International Arctic meetings are often dominated by Canadian contributions, and the programs supported by the *Amundsen* are producing large numbers of primary publications, communications and special issues." While certainly a bold claim, the EP judged it to be fully justified in terms of the quantity and quality of the research enabled by the *Amundsen* and as evidenced in the publication records summarized in Figure 4.

Figure 4 *Amundsen* refereed publications since 2002




Note that data for 2013 is incomplete (*)

Source: *Amundsen* report to the EP

Echoing the panel's strong endorsement of the quality and quantity of research enabled by the *Amundsen*, the EP gave a *high* rating on this assessment criterion. Several positive factors were noted by the panel in reaching this strong and unanimous conclusion.

Related to previous assessment criteria, the panel reiterated the effectiveness of cruise planning and priority-setting processes that are largely driven and determined by the research

community through the Users Committee and implemented as far as possible under the leadership of very experienced scientists.

Judging from their particular areas of expertise and international perspective, panelists noted that among the publications based on research conducted from the platform, the sea ice papers are seminal, as are those describing ecological research on the Beaufort Sea, thereby confirming that the *Amundsen* program has had a major impact (even though not explicitly measured) on the productivity, reach and influence of Canadian Arctic science. The EP also identified the research conducted during overwinterings, which was enabled by the platform, as an innovative and unique contribution to the international science effort.

The panel also commented on the strong iterative nature of the program whereby the quality of the platform and the researchers are each enhanced by the other in terms of generating outstanding science. This points to the intrinsic and sought-after qualities of a truly advanced program such that scientific challenge and discovery drives technological advance, which in turn enables further science achievements.

## 3.4 Leadership and competitiveness

| | |
|---|---|
| EP rating of the overall competitiveness of the research platform in the international context based on research leadership, scientific reputation and other relevant benchmarks | **High** |

Building on the impressive quality and quantity of the research, the EP rated the international competitiveness of the platform as *high*. While the case for this is certainly compelling and convincing, the panel felt that it could be further strengthened by additional metrics that enable comparisons with the productivity and impact of the research conducted by similar organizations in other countries.

As noted previously, the strong engagement of CRCs and CERCs is impressive and speaks to the *Amundsen*'s international leadership and competitiveness by reason of the research status, standing and on-going performance required of chair holders.

The EP noted that the incremental enhancement of the suite of on-board equipment has maintained the *Amundsen*'s competitive edge, including the capability to deploy Zodiacs and other small launches to operate in shallow waters which extends the spatial reach and scientific value of cruise missions.

The panel did not question the fact that the platform has had a major impact on the international visibility and reputation of Canadian Arctic science, noting (as mentioned above) particular fields in which the work is seminal and has made unique contributions to advancing scientific knowledge. One measure of this visibility has been the forging of international partnerships such as the Takuvik program with France, which is viewed as a model of innovative international engagement.

# 4. Extrinsic benefits: Impact on local, regional and national innovation

## 4.1 Mechanisms and strategies for fostering technology and knowledge transfer

| EP rating of the quality and effectiveness of mechanisms to engage end users (both as users of the platform and as end users of the research) | **High** |
|---|---|

The EP assessed the mechanisms for engaging end users as *high*. In so doing, the panel could not separate the attribution between the *Amundsen* platform and the ArcticNet NCE, recognizing the premium that the NCE places on end-user engagement to foster technology and knowledge transfer. There is a real sense, though, that parsing the attribution is moot and not particularly meaningful insofar as retrospective judgments of performance are concerned. The two programs are interdependent such that ArcticNet could not have been created (or renewed) had it not been for the *Amundsen* platform on which much of the ArcticNet science depends (17 of the 38 ArcticNet projects rely on the *Amundsen*). Here, as elsewhere, the implications of the interdependency have more relevance beyond 2018 when the ArcticNet NCE is due to sunset.

In determining its very positive rating, the panel was particularly impressed by the diverse set of end-users encompassing federal and provincial science-based departments and agencies (SBDAs), crown corporations, industry, and communities. The EP also noted the quality and effectiveness of how the evidence from the research is disseminated to both the scientific community and to end-users, identifying the IRIS reports, bathymetric data for hydrographic and geohazard mapping, and sea-bed mapping for geopolitical boundary determination as signal examples. The panel was especially impressed by the success of the *Amundsen* program in its unique outreach to Inuit communities in the area of community health, which the team rightly identifies as among its most important contributions to knowledge translation.

There was some discussion of the capabilities and competitive advantage of the *Amundsen* relative to those provided by consulting companies engaged in Arctic research with the conclusion that the *Amundsen* offers a breadth of independent expertise that consulting companies cannot match. Moreover, the *Amundsen* platform offers not only the scientific credibility of evidence generated from independent science but also unrivalled cost effectiveness for industrial end-users. Furthermore, industry partnerships have been brokered to focus on scientific questions such that the integrity of the research mission is not compromised.

A further positive factor is the representation of end-users on the *Amundsen* Board which, going forward, might be further strengthened given that the Board is a primary forum for determining policy and priorities for platform utilization and resolving conflicts that might otherwise threaten the effectiveness, productivity and impacts of the operational program.

## 4.2 Partnerships with end users

| | |
|---|---|
| EP rating of the extent of formal partnerships with end users | **High** |
| EP rating of the impact of formal partnerships on the platform capacity and capability | **High** |

Formal partnerships with end users were rated as *high*. The EP commented on the impressive breadth and depth of the partnerships to date that were seen to compare favourably with other Arctic research platforms in the diversity of partners. In fact, there are novel elements related to the social and health missions of the *Amundsen* in serving and supporting Arctic coastal communities with the operation of the vessel as a community health facility seen as an especially unique application.

The EP also rated the impact of the formal partnerships on platform capacity and capability as *high.* As mentioned previously, the justification here was based substantially on the evidence that the partnerships have not unduly skewed the science program; rather, deliberate and careful consideration has been given in cruise planning to determine how mutual benefit can be gained by marrying science objectives with the applications and outcomes sought by the partners. As such, the mutual gain has been the basis for securing partner support and resources for capital costs and the O & M required to increase grant funding.

There was some discussion of management's experience in handling the attendant risks of partnering with industry and the perception (at least) of public funds being used to support (subsidize) private enterprise. Management has certainly learned through this sometimes challenging process, and to its credit, has been largely successful in defending its approach to industry collaboration, while recognizing that the terms and conditions of agreements can and should be honed going forward to mitigate (perceived) risks of inappropriate practice. This underlines a point made in section 1.2 about strengthening governance structures and processes where ultimate responsibility for risk management policy and procedures should reside.

## 4.3 Knowledge translation and transfer (KTT)

| | |
|---|---|
| EP rating of the amount of KTT to end users catalyzed by the platform | **Medium** |
| EP rating of the impact of the platform on KTT | **Medium** |

While positive overall, the EP was somewhat undecided in its ratings on the two criteria related to KTT attributable to the *Amundsen* platform which were judged to be *medium*. In part, this reflects the fact that the further downstream the focus of the assessment, the more external factors enter to determine outcomes and impacts. That said, the EP noted that difficulty in quantifying the amount of KTT was due in part to use and uptake not being fully monitored, while recognizing that the capacity of the small *Amundsen* team to conduct monitoring is limited.

Accentuating the positive, the panel noted the many mechanisms in place for KTT: health brochures and reports, industry reports, workshops for end-users, data portals/streams,

international panels (geopolitics), the ArcticNet annual science meeting, IRIS reports, etc. In total, these represent a more extensive set than panelists have observed for other platforms.

The EP took particular note of the work conducted with the oil industry, recognizing its potential importance in informing wise decision-making regarding sites for possible future exploration and exploitation in ways that are environmentally sensitive and sustainable in fragile Arctic ecosystems. Similar arguments apply to the research conducted on energy projects in partnership with major hydro corporations (Manitoba Hydro and Hydro Quebec).

Additional strong points are communication planning and engagement with media that has resulted in substantial high profile national coverage through the CBC, The *Globe and Mail*, etc. The panel also commended management on its proactive and novel engagement with schools and with the creative arts community.

More specifically related to KTT impact, there is at least anecdotal evidence of the impact of the community health surveys and the applications of the seabed mapping data to the geopolitical determination of national sovereignty claims in the Arctic. Evidence was also presented on the positive career development impacts for trainees, not only for those on an academic track but also for HQP recruited by government and the private sector following their training and experience on the *Amundsen*.

The funding support from industry for collaborative projects to some degree speaks for itself in terms of expected value added and impact for private sector partners, though here, as with other KTT applications, there could be value in conducting a systematic and rigorous cost-benefit analysis to quantify impacts.

## 4.4 Benefits from knowledge translation and transfer

| | |
|---|---|
| EP rating of the impact of KTT catalyzed by the platform on end users and the society at large | **High** |

The EP had some difficulty in assessing the demonstrable benefits of the KTT catalyzed by the platform. The evidence presented by the *Amundsen* team was quite sparse; though considerable effort has been made to disseminate the knowledge generated by the research, less attention has been given to monitoring its uptake. That said; it is arguably still quite early to determine the longer term benefits and impacts of the KTT activities.

With this provision, the EP nevertheless rated the downstream impacts on end users (in government, the private sector and local communities) and society at large as (at least potentially) *high*. Several of the examples cited above resurfaced here: geopolitical applications to Canadian territorial sovereignty claims in the Arctic; innovative Inuit health survey methods and results; the IRIS reports; environmental stewardship of resource development opportunities for industry; etc. Here again, the EP felt that additional quantification of impact would be beneficial though quite difficult to achieve and attribute.

As a footnote to the earlier discussion about industry collaboration, the EP endorsed the social responsibility and wise stewardship mandate that the *Amundsen* has assumed in partnering with the private sector on issues of resource development; recognizing the legitimacy of

resource exploration and possible exploitation in the Arctic while seeking to ensure that any activity be informed by strong scientific evidence that best supports an approach which is environmentally and socially responsible.

# 5. Influence of the CFI and funding partners

| EP rating of the overall influence/impact of the CFI and funding partners on the platform | **High** |
|---|---|

The CFI has and continues to be the *sine qua non* for creating and sustaining the *Amundsen* platform and as such its overall impact was rated *high*.

The list of CFI funding investments is impressive and provides self-evident justification for the *high* rating: the initial retrofit and transformation of the vessel through the IJVF; the equipment upgrades through the Leading Edge Fund; support for CRCs and other researchers through the John R. Evans Leaders Fund; and, pending future O & M funding through the MSI Special Competition. All of these, whether required or not by the terms of the award, leveraged substantial support from provincial and industrial partners.

As mentioned repeatedly in this assessment the CFI investments were also the *sine qua non* for the initial funding and subsequent renewal of the ArcticNet NCE. As such, this combination represents a signal example of the aggregate science and technology advantage for Canada derived from its complementary research funding programs with the CFI focused on capital (and now some O & M) funding of infrastructure and the NCE program providing most of the fuel for the research engine without which the infrastructure could have run the risk of becoming expensively redundant.

The CFI influence, however, goes beyond just funding, however, in the sense that the competition criteria, which balance research excellence and benefits to Canada, have had a direct and important shaping effect on program planning and priority setting for the *Amundsen* platform. The strong and positive evidence presented in this assessment testifies to this positive effect without diminishing the undoubted predisposition and commitment shared by the researchers themselves to strive for and achieve this balance. Perhaps less transparent is the attendant influence on the research plans and priorities of the universities that make up the Science Consortium, and especially Université Laval and University of Manitoba as the lead institutions. One need look no further than the commitment of CRC and CERC opportunities as convincing evidence; although this retrospective is strongly reinforced by emergent plans of those institutions to make substantial additional commitments and investments to enhance and advance the future prospects of the platform (see section 6).

A current bottom-line reality therefore is that the *Amundsen* has evolved to fully qualify as a national facility and thereby as an MSI, defined by CFI as:

“collective resources that are typically too large to be funded exclusively by any one institution or organization. An MSI offers specialized capabilities, that are not standard in a discipline or research area, to a broad range of researchers from across Canada and, where appropriate, internationally. The term unique in this context applies to the national research facility itself rather than the research enabled by it, and signifies that its capabilities are not found elsewhere in the country so that a majority (>50%) of those accessing the facility are users from outside the host institution(s) and beyond its regional and provincial borders.”

# 6. Challenges

The *Amundsen* senior management is to be commended for its identification of main challenges facing the future operation and vitality of the platform with the aim of building on and expanding the productivity and impact of its programs for the advancement of science and technologies and for the application of new knowledge to address societal issues in the Arctic region.

Like other CFI-funded national facilities, the *Amundsen* faces serious challenges in meeting its substantial annual operating costs. From their international (USA, UK and EU) perspectives, panel members questioned the absence of statutory government funding recognizing that other sources of potential support, including the private sector, are episodic at best and are likely to be targeted to delivering on specific projects of short(er) term duration. In other words, they are not sustainable over the long(er) term and, at most, should be considered an auxiliary (in some cases matching) source of funding but not the primary source. The inception of the CFI MSI program and its recent expansion to qualify platforms that include the *Amundsen* is a hopeful prospect but its longevity depends on the infusion of new federal funding. A footnote here is that, compared with other MSIs, the *Amundsen* has the advantage that the CCG owns the vessel and therefore assumes a substantial share of the liabilities, as witnessed by its funding of the refit the vessel's engines in 2012.

Throughout this assessment, repeated reference has been made to the vital interdependence of the *Amundsen* and ArcticNet programs. To date, this has been a major strength for both but leaves in question the state of play after the ArcticNet funding ends in 2018, the statutory limit of a two term NCE. The *Amundsen* Board and management are being suitably strategic and proactive in addressing the shortfall that will occur, with plans emerging for a pan-Canadian Arctic Institute that involves a new building at Université Laval (for which Quebec provincial and federal support will be sought), and commitments and support from several other Canadian universities. These plans are linked in part to the federal government's Northern Strategy and its commitment to develop the Canadian High Arctic Research Station. These links notwithstanding, it remains unclear what would be the avenue for sustained O & M funding besides the CFI MSI program, assuming its continuation. The $1.5 billion federal commitment to a Canada First Research Excellence Fund (CFREF) announced in Canada's 2014 federal budget is a possible target though the absence of oceans or the Arctic in the just-released new federal science, technology and innovation strategy[2], which is expected to guide/target CFREF, investments is not an encouraging sign for the *Amundsen*.

The vitality of the *Amundsen* program and its ability to attract the participation of a highly motivated and qualified multidisciplinary research community have been critically linked to upgrading the pool of scientific equipment to support state-of-the-art research. The *Amundsen* report identifies sensible and feasible strategies for continuing enhancement of the equipment centred on periodic CFI Innovation Fund applications and technology partnerships with the private sector related to autonomous underwater vehicle development and the potential for an

[2] *Seizing Canada's Moment: Moving Forward in Science, Technology and Innovation* 2014, Industry Canada (http://www.ic.gc.ca/eic/site/icgc.nsf/eng/h_07419.html).

Industrial Research Chair from the Natural Sciences and Engineering Research Council of Canada.

The recruitment and retention of highly qualified and experienced technical staff is another challenge, though one that has good prospects of being addressed successfully, especially as the mission and reputation of the *Amundsen* platform attracts suitably ambitious candidates. Moreover, *Amundsen* senior management is well connected through their national and international networks with the venues where prospective hires are trained or currently employed.

A challenge not listed in the *Amundsen* report and only briefly considered at the site visit is that of securing "champions" in government and industry for the *Amundsen* program. Given the relatively high profile of the *Amundsen* in the media, the federal government's Northern Strategy, the political and economic importance for Canada of Arctic sovereignty and resource issues, the commitment to the development of the Canadian High Arctic Research Station, and the Prime Minister's annual summer visits to the Arctic, the stars would seem to be in alignment for strong political support, especially at the federal level. But nothing should be assumed and so cultivating the support of political and industry champions should be considered a strategic priority building on the strong connections already established with the federal SBDAs (Fisheries and Oceans Canada, Natural Resources Canada, Aboriginal Affairs and Northern Development Canada, Foreign Affairs, Trade and Development Canada, etc.). This comes full circle back to governance and the strengthening the Board to provide the wise counsel required to open doors in Ottawa, Quebec City and with other provincial governments, as well as with industry leaders, especially in the resource sector. The positive impact of the *Amundsen* program on Arctic communities also creates the opportunity for securing the strong support of Inuit leaders.

# 7. Closing remarks

***"The Amundsen clearly represents a remarkable facility that has been transformative with respect to Canadian Arctic science and the Canadian scientific community."* — EP member**

| | |
|---|---|
| EP rating of the impact of the platform on the national research landscape | **High** |

The panel was uniformly impressed with what has been achieved by the *Amundsen* platform both in enabling science of the highest international quality and in facilitating the translation and application of new knowledge to address societal issues of major consequence for the Arctic regions of Canada and by extension to other Arctic settings.

With few exceptions, the EP rated the *Amundsen* platform as *high* in all areas, and was unanimous in assessing its impact on the national research landscape as *high* overall. In so doing, the panel validated the bold claims about performance and impact made in the *Amundsen* report and underscored in management's presentations at the site visit.

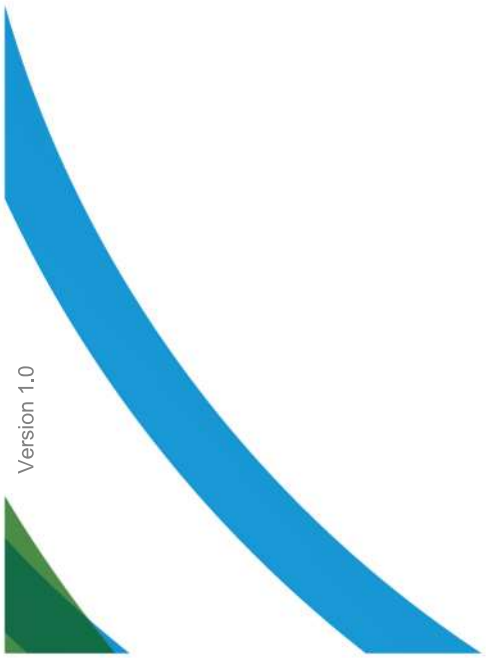
True to its mandate, "the *Amundsen* has re-energized Canadian Arctic science by (1) providing unprecedented access to the Arctic Ocean and its coastal communities to Canadian researchers and their international collaborators; (2) introducing big science led by large multidisciplinary teams to the Canadian Arctic; (3) consolidating international collaborations; (4) enabling Canada's NCE ArcticNet; (5) offering a unique environment for the training of the next generation of Arctic Ocean specialists; and (6) supporting research partnerships with the private sector."

It follows that CFI should have no doubt about the value of its investment to the capital and operating support of the platform over the past decade; indeed, the EP strongly encourages the federal funding agencies to provide and sustain competitive funding mechanisms whereby this remarkable asset can continue to flourish and thereby enhance its high-quality and high-impact Arctic research for Canadian science and society.

The *Amundsen* fully qualifies as a national facility, supported by its uniqueness, mandate, capacity and contribution to advancing science in Canada and internationally. It addresses leading-edge scientific problems of significance, scope and complexity and generates new knowledge and manifold benefits for Canada and Canadians.

# Summary of ratings

| | |
|---|---|
| **Governance and management** | |
| EP rating of the quality and effectiveness of the planning and performance monitoring processes to achieve platform's short- and long-term objectives | Medium |
| **Research capacity** | |
| EP rating of the current nature and scope of platform capabilities (including infrastructure, personnel competencies, service functions) | High |
| EP rating of the adequacy of the platform enhancements since the base year in order to keep offerings competitive | High |
| EP rating of the overall approaches to sustainability of the platform and its related services | Medium |
| EP rating of the magnitude and value-add of the platform on the structure of the Canadian research ecosystem | High |
| EP rating of the impact of the platform on advancing the training of undergraduate and graduate students, and postdoctoral fellows since the base year | High |
| **Research enabled** | |
| EP rating of the extent of the utilization of the platform and its services in relation to capacity, demand and performance targets | High |
| EP rating of the extent to which the platform is accessible and used by a broad range of national and international users from diverse sectors | Medium |
| EP rating of the extent to which the platform has established and fostered collaborative relationships across disciplines, institutions and sectors | High |
| EP rating of the impact of the platform on the relevance, type, quantity and quality of research enabled | High |
| EP rating of the overall competitiveness of the research platform in the international context based on research leadership, scientific reputation and other relevant benchmarks | High |
| **Extrinsic benefits** | |
| EP rating of the quality and effectiveness of mechanisms to engage end users (both as users of the platform and as end users of the research) | High |
| EP rating of the extent of formal partnerships with end users | High |
| EP rating of the impact of formal partnerships on the platform capacity and capability | High |
| EP rating of the amount of KTT to end users catalyzed by the platform | Medium |
| EP rating of the impact of the platform on KTT | Medium |
| EP rating of the impact of KTT catalyzed by the platform on end users and the society at large | High |
| **Influence of the CFI and funding partners** | |
| EP rating of the overall influence/impact of the CFI and funding partners on the platform | High |
| **Conclusion** | |
| EP rating of the impact of the platform on the national research landscape | High |



Version 1.0

**Research builds communities**
**La recherche au service des collectivités**


**450-230 Queen Street**
**Ottawa ON K1P 5E4**
**Tel 613.947.7260**
**Fax 613.943.0227**

**450-230 rue Queen**
**Ottawa ON K1P 5E4**
**Tél 613.947.7260**
**Téléc 613.943.0227**