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**ARICE: Arctic Research Icebreaker Consortium:**

**A strategy for meeting the needs for marine-based research in the Arctic**

# **Deliverable 1.6.** Modalities of European PRVs' ship-time collaborations and exchanges

# Submission of Deliverable

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# Contents

## Abstract

Part of the ARICE project (WP1) focusses on investigating the feasibility of transnational coordination of Arctic research vessel use. Arctic research is expensive and there is much to be gained from reflecting on current practises and identifying future opportunities. Earlier ARICE deliverables have examined the current status of transnational access to Polar research vessels and how the vessel fleet capacity can be utilized optimally. The focus of this deliverable is to map how an EU initiative can facilitate transnational research expeditions. The current vessel fleet is summarised, and existing national and international initiatives are highlighted as inspiration towards a new effort for optimising polar research vessel use. A path forward is suggested which involves the formalisation of a sustained European funding framework for vessel charter which would be a great benefit to European research, international collaboration and facilitate the optimal use of research vessels across Europe and motivate individual nations to maintain their research vessel infrastructure.


## 1. The necessity of Arctic marine research

The impacts of recent climate change have been most pronounced in the Arctic. Air temperatures have warmed faster than in other regions and the hydrological cycle is changing with the increased melting of the Greenland Ice Sheet and increasing summer Arctic river discharge. This melting produces changes in water exchange with the Atlantic and Pacific Oceans, forcing the Arctic Ocean to respond with warmer surface waters, greater areas of summer sea ice melt, and massive loss of land fast ice. Through its connectivity to the Atlantic, these changes have global repercussions potentially influencing overturning circulation, ocean carbon uptake, and marine productivity. The impacts for Europe spread across changing climate, redistribution of fisheries, opening of new shipping routes, exposure of new natural resources for extraction and developments in tourism. To ensure a knowledge based and sustainable transition into this new era it is imperative that our understanding of the natural environment in the Arctic is improved. An integral part of this is support and development of marine Arctic research and infrastructure.

Oceanographic research and infrastructure operation is expensive and even more so when we take into account Arctic conditions. Historically most Arctic research has been carried forward in the spirit of exploration, national pride (demonstration of capabilities) and territorial claims, or often in a combination of the previous. However, this has led in some cases to sporadic investments by individual nations that for the most part are not coordinated internationally. But it should also be noted that several larger nations prioritize fundamental research and an Arctic presence and therefore, have sustained Arctic marine research programs, with broad long-term political support.

A central objective of the ARICE project is to investigate the feasibility of transnational coordination of Arctic research vessel use. The questions we address in ARICE are: i) What is the current status of transnational access to Polar research vessels (ARICE D1.2 (2019a)); ii) Is the current Arctic vessel fleet capacity utilized optimally (ARICE D1.3 (2019a) & ARICE D1.4 (2020)); and iii) How can an EU initiative facilitate transnational research expeditions? The latter will be addressed here.

## 2. The research vessel fleet

The current fleet of vessels with Polar classification operating in the Arctic are listed in Table 1. They span a wide range in age, size and capability. The span in size and capability is advantageous and with the correct coordination can be fully cost effectively utilized. However, the lack of recent investments in new vessels is alarming (Figure 1). In the last 20 years, only four vessels have come into service. The

European fleet is therefore aging and due to the lack of investment over the last 15 years, accessibility to Arctic seas for European scientists is at stake and there will be a greater dependency on access to non-European vessels.

Arctic expeditions demand different vessel specifications depending on the scientific focus. Excessive duplication of vessel capabilities and associated functional redundancy is an expense that should be avoided, in particular in light of the limited investment by European states in new vessels (Figure 1). It would therefore be beneficial to develop a pan European coordination of vessel charter to ensure optimal usage (maximum days at sea) and therefore minimize running costs for all nations involved. Clearly central Arctic operations place tougher demands on ship design than expeditions in regions with seasonal ice coverage along the Arctic perimeter. The question is how to effectively manage ship charter internationally and how to provide enough incentive for ship operators to contribute.

**Table1.** European vessels with length > 50 m able to support Polar ocean research. Only vessels with Polar Class certification are included (see appendix).

| Vessel | Country | Operator | Polar Code Cat. | Age (launched) |
|---|---|---|---|---|
| DANA | Denmark | DTU | B | 38 (1981) |
| POLARSTERN | Germany | AWI | A | 37 (1982) |
| ODEN | Sweden | SMA (user SPRS) | A | 31 (1988) |
| HELMER HANSEN | Norway | UiT | B | 31 (1988) |
| ARANDA | Finland | SYKE | B | 30 (1989) |
| JAMES CLARK ROSS | UK | BAS | A | 29 (1990), Decom. |
| LAURA BASSSI | Italy | OGS | A | 24 (1995) |
| MARIA S MERIAN | Germany | IOW | B | 14 (2006) |
| KRONPRINS HAAKON | Norway | UiT/IMR/NPI | A | 1 (2017) |
| DAVID ATTENBOROUGH | UK | BAS | A | (2020), not yet operational |
| Under Construction | Greenland | GNI | B | (2021) |

*Abbreviations: AWI-Alfred Wegner Institute; SMA- Swedish Maritime Administration SPRS-Swedish Polar Secretariat; SYKE- Finish Environmental Institute; MRI- Marine Research Institute; DTU- Technical University of Denmark; BAS- British Antarctic Survey; UiB- University of Bergen; UiT-University of Tromsø; IMR-Institute of Marine Research; NPI- Norwegian Polar Institute; IOW-Institute for Baltic Sea Research; OGS- Istituto Nazionale di Oceanografia e di Geofisica Sperimentale; GNI-Greenland Institute of Natural Resources.*

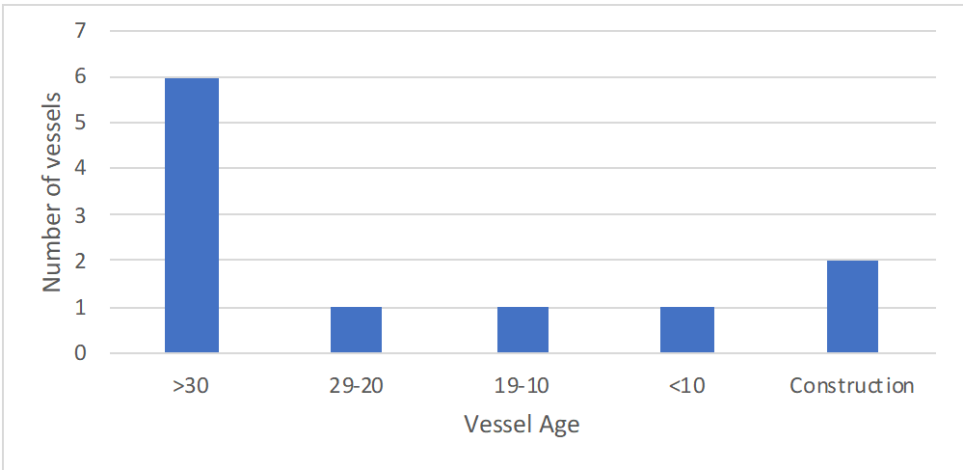



**Figure 1:** An aging fleet in need of replenishment. The number of European research vessels (length >50 m) capable of operating in Polar water for different age classes.

## 3. Collaboration and exchange

There already exists a considerable amount of scientific exchange and interaction between European countries. This is partly driven by European funding initiatives but also by the multidisciplinary nature of marine science, which motivates and necessitates collaboration. An additional factor is research infrastructure: Those nations with a greater infrastructure capacity also gain from this investment through a greater extent of international participation and scientific collaboration.

Overall, European research vessel operations can be grouped into two coarse categories: Bottom-up driven research expeditions driven by current research initiatives/demands; or national contributions to sustained monitoring responsibilities and long-term observational networks (ARICE D1.2 (2019a)). The first is ad hoc in nature while the latter more or less binds ships to fixed cruise routes and periods of the year.

Similarly, the financing of ship operations can be segregated with some ships supported solely through national centralized funding while others generate income through ship charter in periods with no national commitments.

Currently there exists extensive good will within Europe to make berths internationally available on predefined oceanographic expeditions for limited or no cost. What often lacks are the comparatively small funds required to support transnational access (berth fees, travel, freight and subsistence) which operators and users cannot also be expected to cover and funding for additional ship time to capitalise on the fact that the vessel is available in a given location (limited or no transit costs for research). This has in part been addressed in initiatives such as the H2020series of EU funded EUROFLEETS projects, and the H2020 ARICE project, but a more permanent European solution (rather than short-term project based) would be beneficial and more efficient for the community.

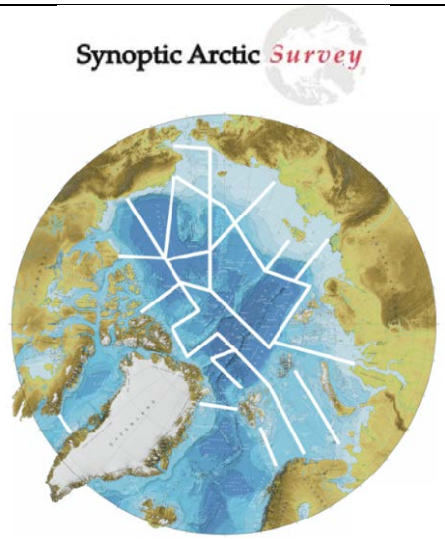
At the other extreme lie expeditions based on ship charter using funds acquired for a specific scientific goal. In this scenario, the ship operators and supporting agencies have less control on the allocation of access for a broader international scientific community. Overall, a consortium is already formed and has collaborated in generating funds for an expedition.

## 3.1. Inspiration from existing platforms: science driven initiatives

There are several initiatives that can provide inspiration for the future evolution of how European vessels are utilized. The Synoptic Arctic Survey (Box 1) is a good example a science driven initiative to optimise the use of polar research vessels in an internationally coordinated sampling program over a two year period. The effort will provide comprehensive coverage of a suite of variables collected using standardised methods and offer a reference for current and future Arctic change. SAS represents an enormous science driven initiative and the momentum and experience gained can be harvested to inspire sustained collaboration in polar observations.

**Box 1:** Synoptic Arctic Survey (SAS)

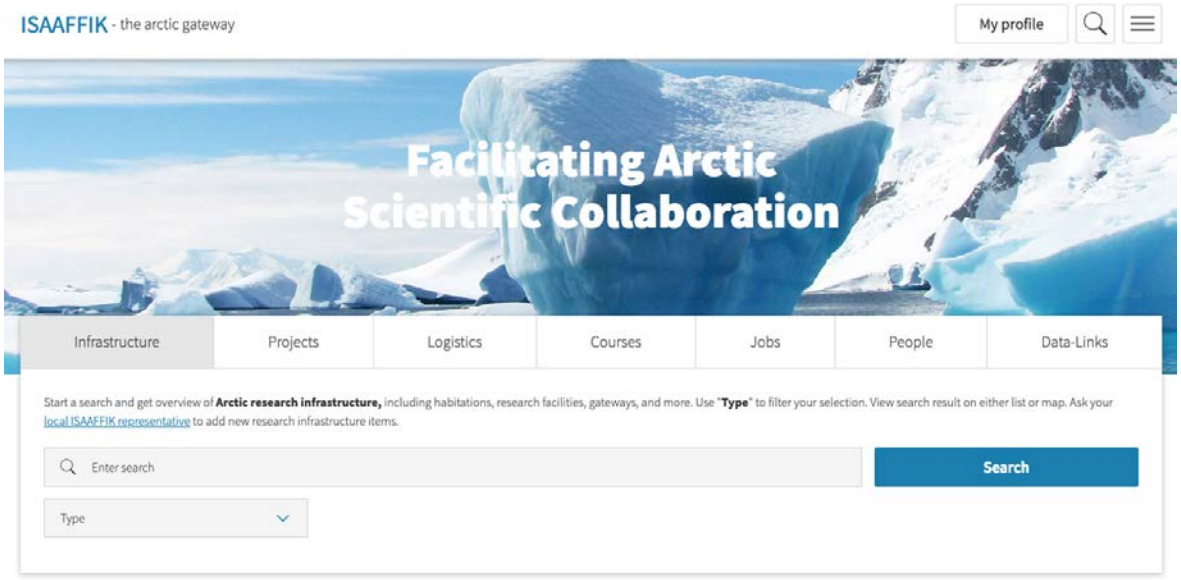



The **Synoptic Arctic Survey** (SAS) is a bottom- up, researcher driven initiative that seeks to define the present state of the Arctic Ocean (AO) and understand the major ongoing transformations by collecting empirical data in the Arctic basin that cannot be done in any other way than by polar research vessels (Anderson et al. 2018, 4; Synoptic Arctic Survey 2019). Despite the fact that the central AO is relatively small, it has been fairly inaccessible for research and data collection both because of logistic and political reasons. The SAS dataset will provide a valuable baseline for future studies. It will include vessels from at least five nations and requires meticulous planning of research vessel usage, equipment as well as joint funding from countries with polar interest and experience. Ideally the survey would be repeated in ten years – a plan that would benefit not only from the experience of the current effort but also from the harmonisation of the European Arctic Research fleet and the creation of an international Arctic Research Icebreaker Consortium.

Another initiative is the Arctic portal, ISAAFFIK.org (Box 2). Among other functions, this site serves as a message board for scientists to share costs for logistics and advertise plans so that others (authorities, scientists and operators alike) can be aware of activities. Logistics in the Arctic is expensive and therefore there is a high potential to economise on these costs ensuring that the full capacities are utilised, be it cubic meters available in freight or share of helicopter or boat charter costs. This initiative is particularly beneficial for small operations in vast remote regions (e.g. Greenland) and is being continually further developed. The calendar and map functions are very effective at documenting activities and opportunities internationally in the region. Additionally, the Greenland authorities are working to integrate their expedition and research permit granting system with the platform. Expansion and widespread use of such a platform can help us obtain and maintain an efficient and optical use of marine arctic infrastructure.

**Box 2:** ISAAFFIK.org the Arctic Gateway




In Geenlandic "Isaaffik" means gateway. The portal is a user driven website supporting research and collaboration providing a forum for inspiration and synergy for research, education, consultancy and logistics.

The platform is open for anyone to join and register and start contributing and benefiting from the site to announce projects, expeditions, courses, activities, and participate in informal discussions. The user group consists of scientists, students, administrators, and decision makers.

It is currently supported by the ISAAFFIK partner group of Danish and Greenlandic institutions and authorities.

Another source of inspiration is the creation of national ship charter funding mechanisms. In Denmark, the Danish Centre for Marine Research is a virtual centre owned together by marine research institutions and funded by the national budget. The majority of these funds are available for ship charter for oceanographic research with vessels greater than 20 m in length. Scientists submit applications on behalf of a consortium and the applications are peer-reviewed and prioritized/selected. International participation is welcomed and there is no limitation on geographical region for the expedition or origin of the vessel. Funding requires only that the activity has to benefit Danish marine science. The initiative helps support Danish vessel operation (additional charter lowers annual operating costs for ship operators) and stimulates the Danish marine research environment. Inclusion of foreign scientists on expeditions is also encouraged. A European scale initiative inspired by these operations would provide the similar benefits for all member states operating vessels.

## 3.2. Inspiration from existing platforms: vessel operation initiatives

Several European nations already share information on their cruise planning via the Marine Facilities Planning software/portal (https://marinefacilitiesplanning.com). The focus of the portal is on vessel management for ship operators, but it also provides all users with a very good overview of timing and location of cruises. Similarly, IMR in Norway coordinates the usage and planning of Norwegian fleet via the portal https://toktsystem.imr.no/calendars. The focus here is on national planning of vessel use.

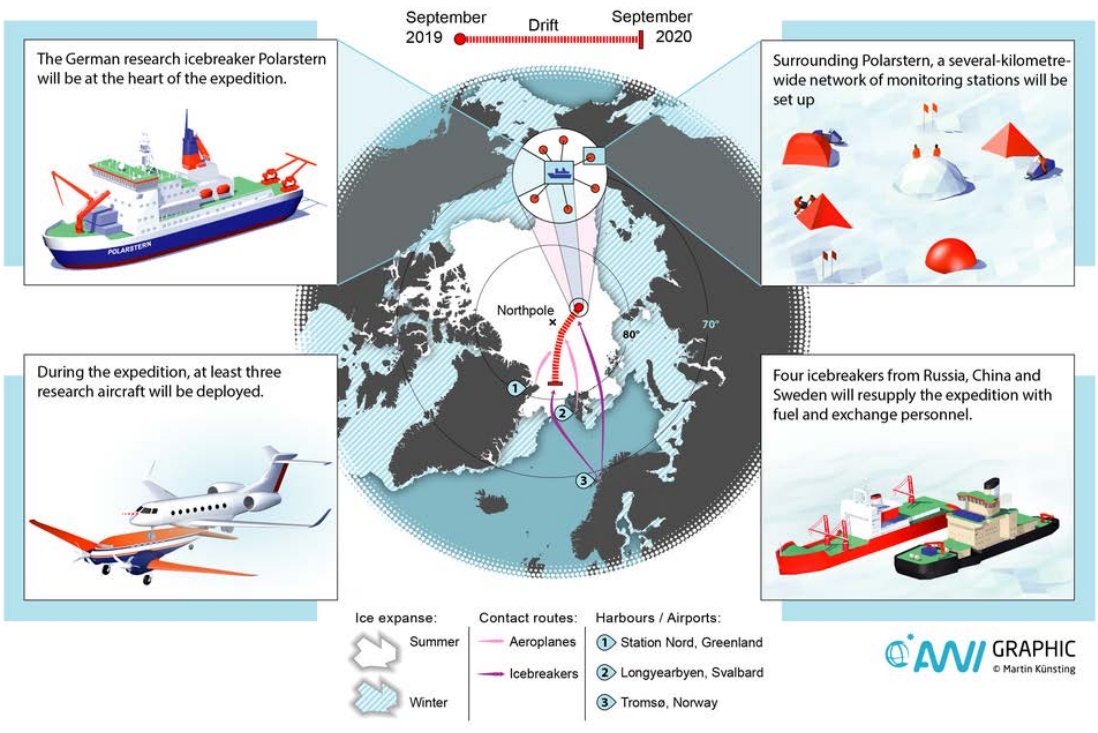
The Ocean Facilities Exchange Group is a consortium of ship operators which facilitates collaboration and cooperation on a no money exchange basis, i.e. barter (http://www.ofeg.org). The consortium consists of operators from France, Germany, Netherlands, Norway, Spain and the UK. OFEG

offers the marine science community access to a wider range of research vessels and equipment than would otherwise be possible through national programs alone. The equipment includes manned submersibles, remotely operated vehicles (ROVs), towed arrays and shipboard surveying systems. These systems are expensive and seldom in continuous use so it is advantageous to have transnational collaboration. Such coordination also offers an opportunity to optimise vessel use during long passage legs between areas of scientific interest, and allow marine scientists access to a wider range of geographical regions in a given year. The platform also offers coordination of large marine investments. The barter system implies that there is an exchange of ship time or equipment usage based on a predefined and agreed assessed vessel or equipment "value". All operating costs remain with the operators/owners.

The current Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) is an example of extensive international collaboration on Polar science and logistics (Box 3). While PRV Polarstern is frozen into the ice, an international fleet is providing logistical support. Although initiated by Alfred Wegner Institute in Germany, its planning quickly became a major international collaborative effort between seventeen nations coordinating five icebreakers for supply of fuel, provisions and staff.

**Box 3.** Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC)

MOSAiC is a major international research initiative initiated by the Alfred Wegner Institute (AWI) and developed under the umbrella of the International Arctic Science Committee. The German icebreaker Polarstern is drifting with the sea ice across the central Arctic Ocean between 2019 and 2020 to explore the mechanisms acting in the coupled climate system and investigate environmental wintertime conditions in the Arctic Ocean. The focus of the research during the drift will be on direct in-situ observations of the processes that couple the atmosphere, ocean, sea ice, biogeochemistry and ecosystem. Its goal is to improve regional and global climate models and weather forecast models.



# 4. A path forward

The European Marine Board report on research vessels concludes that the rate of replacement of Polar research vessels is too low to maintain the fleet size (Nieuwejaar et al 2019). A reduction in the fleets' size therefore is deemed inevitable. The report highlights the need to formalise a system for transnational access. A mechanism to ensure access for nations with no polar platform and to ensure efficient use of existing infrastructure in Europe.

Several existing platforms offer operators with means to optimise and coordinate operations and logistics. These should be encouraged to expand and include more research vessels. While these improve the efficiency of use of the infrastructure, they offer only part of the solution. Nations with no polar vessels remain outside the barter system.

What is lacking is a permanent European funding system in support of Transnational Access that could support the funding of research vessel charter for international collaborative research efforts. This could be addressed by using the funding model from the Danish Centre for Marine Science at an European level, where a scientific board allocates funding for ocean vessel research expeditions irrespective of national ownership. This would also provide an incentive for national funding of research vessel construction, as there would be a sustained opportunity for additional ship charter from research projects in Europe. The effort would benefit collaboration within the EU and between the EU and North America and Asia.

The recent series of H2020 projects focused on facilitating scientific exchange, training and access to research vessels, have documented the feasibility and necessity of such a program. The initiatives summarised here and in the earlier ARICE deliverables also demonstrate the ability of the research vessel operators and users (scientists) to coordinate and organise activities in the interest of optimal use. A logical next step is to recognise these developments and the requirements of the community and formalise a sustained funding program for trans- national access to and charter of research vessels. This will inspire further growth in international collaboration, optimal use of vessel capacity and ultimately likely encourage member states to maintain and upgrade their research vessel fleets.

# 5. References

ARICE D1.2 (2019a) Deliverable 1.2. Guidelines on the conditions to access European PRVs.

ARICE D1.3 (2019b) Deliverable 1.3. Map of potential beneficiaries of a coordinated PRV fleet.

ARICE D1.3 (2019b) Deliverable 1.4. Identification report on contribution of a coordinated PRV fleet to fulfilling EU member states' research interests in the Arctic Ocean.

Nieuwejaar, P., Mazauric, V., Betzler, C., Carapuço, M., Cattrijsse, A., Coren, F., Danobeitia, J., Day, C., Fitzgerald, A., Florescu, S., Ignacio Diaz, J., Klages, M., Koning, E., Lefort, O., Magnifico, G., Mikelborg, Ø., Naudts, L. (2019) Next Generation European Research Vessels: Current Status and Foreseeable Evolution. Heymans, JJ., Kellett, P., Viegas, C., Alexander, B., Coopman, J., Muñiz Piniella, Á. [Eds.] Position Paper 25 of the European Marine Board, Ostend, Belgium. 140pp. ISBN: 978-94-92043-79-5 DOI: 10.5281/zenodo.3477893

# Appendix

The International Maritime Organization (IMO) adopted the International Code for Ships Operating in Polar Waters (The Polar Code) on the 1st January 2017. It included amendments that make it mandatory under both the International Convention for the Safety of Life at Sea (SOLAS) and the International Convention for the Prevention of Pollution from Ships (MARPOL). The Code certifies ships operating in polar regions into categories:

| **Category** | **Ice Class** | **Ice limit (m)** | **Operating Capability** |
|---|---|---|---|
| A: ship designed for operation in in at least medium first-year ice, which may include old ice inclusions. | PC1 | None | Year-round operation in all polar waters |
| | PC2 | None | Year-round operation in moderate multi-year ice |
| | PC3 | >3 | Year-round operation in second-year ice, which may include multi-year inclusions |
| | PC4 | 3 | Year-round operation in thick first-year ice, which may include old ice inclusions |
| | PC5 | 1.2 | Year-round operation in medium first-year ice, which may include old ice inclusions |
| B: ship designed for operation in at least thin first-year ice, which may include old ice inclusions. | PC6 | 0.7 | Summer/autumn operation in medium first-year ice, which may include old ice inclusions |
| | PC7 | 0.7 | Summer/autumn operation in thin first-year ice, which may include old ice inclusions |
| C: ship designed to operate in open water or in ice conditions less severe than those included in Categories A and B. | | | |