# ICARP IV Research Priority Team (RPT) 7

## *Technology, Infrastructure, Logistics, and Services*

## Town Hall Session, ICARP IV Summit

**Marin Kuizenga & Dariusz Ignatiuk & Cana Uluak Itchaqiyaq**

ICARP IV
INTERNATIONAL CONFERENCE ON ARCTIC RESEARCH PLANNING

**27 March 2025**
Boulder, Colorado, USA

Photos: Centre for Polar Studies archive

# ASSW Code of Conduct

- Strive for transparent and open communication.
- This is an opportunity to be curious - put aside assumptions.
- Share the air - we all have something to learn and something to share.
- Be considerate, respectful, and collaborative in speaking and listening.

**Read the full Code of Conduct**
**https://assw.info/meeting-info/assw-code-of-conduct**

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# Working theme

Innovative technology, sustainable infrastructure, as well as robust logistics and services are integral to implementing Arctic research priorities. Automation and remote operations, the development of new large-scale research equipment and monitoring systems, and the necessity of sharing of national infrastructure and services will advance arctic research over the next decade and beyond.


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# Research Priority Team 7

Co-chairs

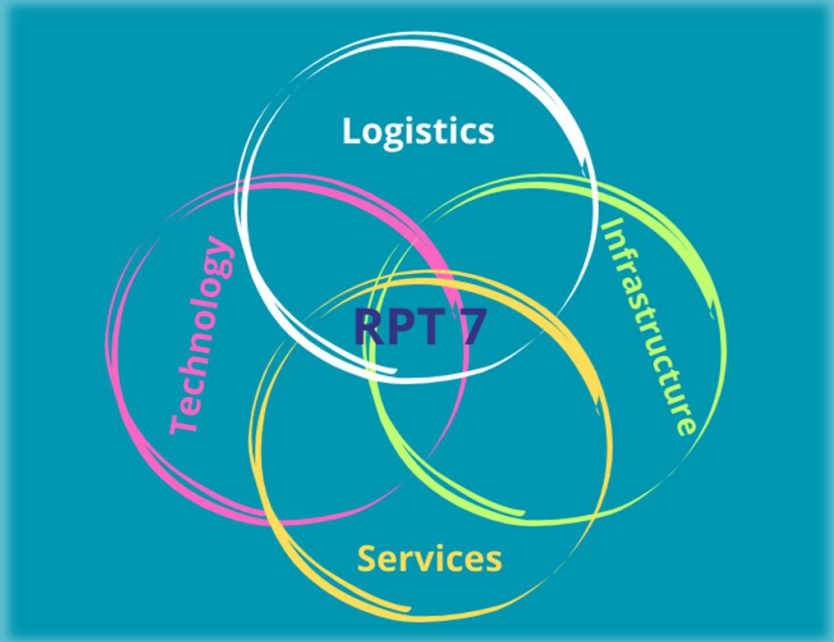
- Dariusz Ignatiuk, University of Silesia in Katowice/Polish Polar Consortium
- Marin Kuizenga, University of Alaska, Toolik Field Station
- Cana Uluak Itchuaqiyaq, Virginia Tech University & RespectfulResearch.com

Many thanks to Julia Muchowski, Elmer Topp-Jørgensen, Marie Frost Arndal, Morten Rasch, Syndonia Bret Harte, Verena Mohaupt, Rohit Srivastava, Archana Singh, Yutaka Tobo, Daniela Marianne Regina Walch, Hannele Savela, Marcin Wichorowski, Shridhar Jawak, Anneli Strobel, Josef Elster, Hideki Kobayashi, Benoît Pirenne, Falk Huettmann, and Bill Manley.

RPT 7 Members:
https://icarp.iasc.info/engagement/research-priority-teams/research-priority-team-7

# How we structured our work

- **Identified team members in sub-specialties**
- **23 Members**
  - North America - 9
  - Asia - 4
  - Europe - 12
- **Formed sub-teams**
- **Regular RPT7 meetings – sub-teams and all group**
  - Developed their own methodology
  - Held meetings & discussions at sub-team and general level
- **Responded to a common template:**
  - 5 Gaps
  - 5 Priorities
  - Implementation



# Research Priority Team 7: Technology, Infrastructure, Logistics, Services

Aggregated priorities into categories:

- Appropriate technology/Sustainability
- Continuity
- Equitable Indigenous Participation and Governance
- Food Security
- Funding
- International Collaboration
- Remote Access
- Remote Instrumentation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# RPT 7 survey - Google Forms


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# Cana Uluak Itchuaqiyaq, PhD

Intersection of research and Indigenous communities

**Persistent irony of inclusion:**
Calls to “integrate Indigenous Knowledge and communities into XYZ” have long been framed as a goal in itself—yet ironically, this supposed integration rarely translates into the articulation of actual research goals, leaving Indigenous inclusion perpetually aspirational rather than actionable.

# Logistics

- Scientific work in the Arctic depends heavily on logistical support.
- Logistics in high latitudes are especially extensive, requiring special technology.
- At present, logistics costs claim approximately one-third of Arctic science funds.
- With the current state of arctic logistics, investigators and facilities managers have limited abilities to predict and plan for research opportunities.

https://www.science.org/content/article/fieldwork-arctic-surprisingly-costly-limiting-research-done-there

# Logistics - Needs

- Sustainable Arctic logistics and infrastructure development
- Data gaps, and integration of observing systems
- Integration of Indigenous knowledge into research

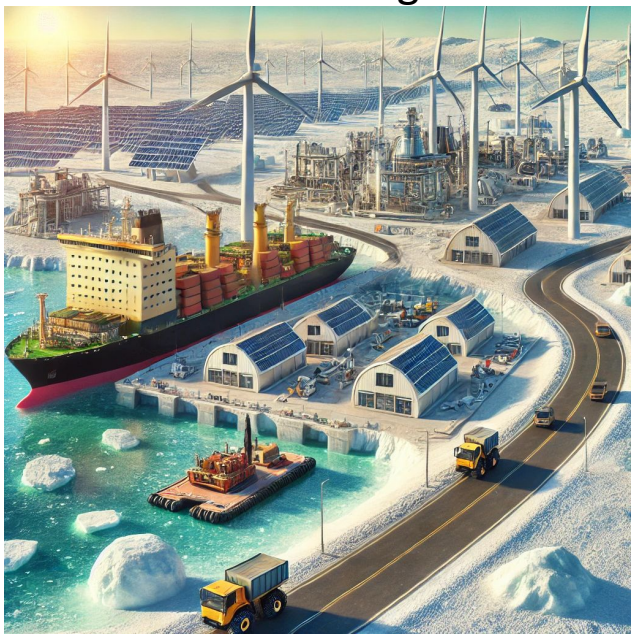




Image Source: AI

# Logistics

## Priority 1: Sustainable Arctic Infrastructure and Logistics

- Develop sustainable logistics and infrastructure that minimize environmental impact and adapt to Arctic conditions.
- Reduce reliance on diesel by adopting **wind turbines, hybrid solar systems, and advanced energy storage** suited for cold climates.
- Implement **cleaner fuels and green technologies** for vessels and land-based infrastructure, testing Arctic solutions for broader energy applications.
- Enhance **automation for data gathering and remote field station access** to maintain long-term observations efficiently.
- Foster cooperation among **governments, funding agencies, private companies, and Indigenous communities** to promote sustainability.

# Logistics - Implementation

- Initiate pilot projects to create renewable energy solutions for Arctic logistics, including solar-powered or hybrid icebreakers, and low-emission transport vehicles.
- Invest in research and development of automated systems for logistics operations in remote areas to reduce human intervention and environmental impacts. Use of AI and ML in logistics.
- Establish partnerships between governments, the private sector, and Indigenous communities to co-create infrastructure projects that address needs, respect ecological sensitivities, and minimize disruption.

# Q&A

If you are dissatisfied why, what is missing?

What is the best way to implement this priority over the next 10 years?

Q1: What role does automation and remote operations play in improving Arctic logistics efficiency and safety? In decision-making?

Q2: What governance frameworks can ensure equitable participation of Indigenous communities in Arctic logistics planning and decision-making?

# Infrastructure

Research Infrastructure: platforms that accommodate people and instruments

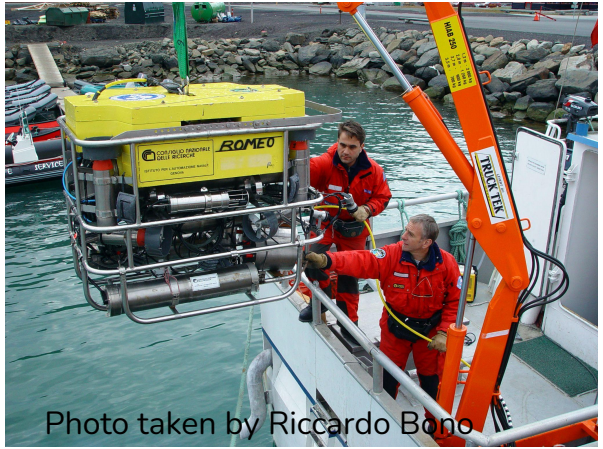
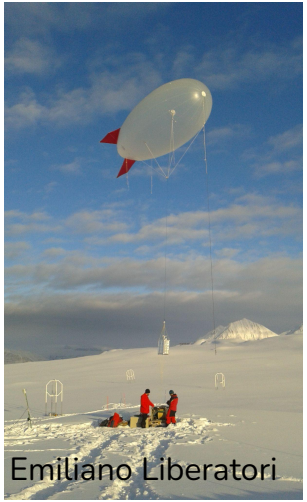


Photo taken by Riccardo Bono


Emiliano Liberatori


Morten Rasch

Ida Kinner


Marie Frost Arndal

# Infrastructure - Need

Research infrastructure is **necessary** to observe, understand, and predict Arctic change. However, existing infrastructure is **not sufficient**.


We need to **maintain** existing infrastructure while **developing** new spatially distributed infrastructure that is environmentally friendly and serves the needs of science and society.

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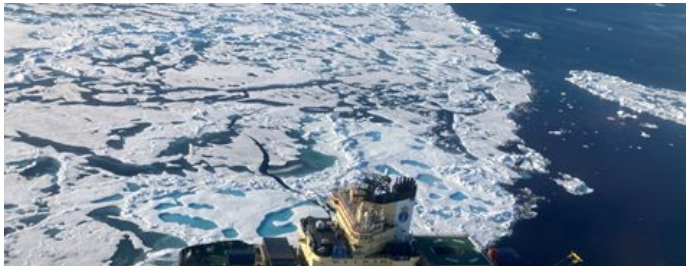
Research Priority Team 7: Technology, Infrastructure, Logistics, and Services

# Infrastructure

Priority 2: Continuity and development of **distributed research infrastructure** to provide sustainable observing platforms in support of **societal and scientific needs**.



# Infrastructure - Implementation

1. Maintain **continuity of funding** for existing long-term observation platforms and develop **spatially distributed** observation platforms, to ensure:
   - **spatial coverage** (representative sampling)
   - **in-depth**, **process-based** measurements, particularly on land (flagship observatories)
   - **continuous, long-term, year-round observations** (long-term trends & short-term variability).

   Local observers can extend both the geographical range and temporal coverage of observations.
2. Develop and implement socially and environmentally **sustainable practices** for building and operating infrastructure jointly with **local / Indigenous communities**.
3. Minimize the environmental impact of infrastructure through **sustainable facilities** and **capabilities** in close communication with scientific and local communities, e.g. **renewable energy sources, automating** both monitoring instrumentation and remote vehicles.
4. Research on **green technologies** for shipping, icebreakers, and land-based infrastructure.

# Q&A

If you are dissatisfied why, what is missing?

What is the best way to implement this priority over the next 10 years?

Q1: Considering your key challenges, what do you need to address them?

Q2: How can we strengthen indigenous leadership and participation in research infrastructure planning and operation?

# Services in Arctic research

- **Operational support & safety** – Manage logistics, risk, and real-time communication for safe fieldwork.
- **Weather forecasting & emergency response** – Provide climate updates and rapid rescue support.
- **Remote sensing & monitoring** – Use satellites, drones, and aerial surveys to track environmental changes.
- **Data management** – Ensure accessible, standardized, and integrated research data.
- **Indigenous collaboration** – Integrate traditional knowledge into research services.
- **Sustainability** – Support eco-friendly operations.

# Services

## Priority 3: Enhance Remote and Virtual Access to Research Infrastructure and their services

- Strengthen and integrate Arctic observing systems
- Enhance remote and virtual access to Research Infrastructures (RIs)
- Integrate indigenous knowledge into Arctic research
- Advance sustainable Arctic infrastructure and logistics
- Develop next-generation remote sensing technologies

# Services - Implementation

## Priority 3: Enhance Remote and Virtual Access to Research Infrastructure and their services

- Develop international agreements, funding instruments, access programmes and standardized logistical sharing services/platforms for sharing national infrastructure
- Ensure proper registration of infrastructure information and their services in relevant catalogues, such as RoPON, Polardex, INTERACT GIS
- **Data needs and requirements:**
  - High-speed, secure data transmission networks
  - Standardized data formats and metadata protocols
  - Real-time data streaming capabilities
  - Compliance with FAIR and CARE principles
- **Who should implement the actions:** Project Consortiums, RI operators and service providers, universities, technical partners (e.g. software developers, cybersecurity experts), funding bodies, authorities, communities

# Q&A

If you are dissatisfied why, what is missing?

What is the best way to implement this priority over the next 10 years?

**Q1: Enhancing remote & virtual access to research infrastructure and their services**

- How to assure that there is a match between the needs of the research and the services provided by the RIs?
- How can national research infrastructures be better integrated into global access platforms?

# Technology

- Technology exists to respond to the needs of research – so we won't have intrinsic formal priorities
- However technology advances independently and we can leverage some of it: renewable power and storage, sensors, remote sensing, vehicles, communication, biology, …


Image: Canadian Space Agency

Image: SpaceX Starlink

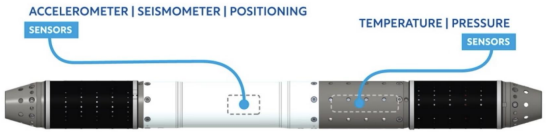



Image: Alcatel Submarine Network

Image: National Oceanographic Centre

Image: Ocean Networks Canada

# Technology

## Priority 4: Development and deployment of next-generation remote sensing technologies and related services to strengthen Arctic climate, environmental, and ecosystem monitoring

- The Arctic's rapidly changing climate demands enhanced **real-time monitoring** to better predict and mitigate environmental shifts, and for better informed decision-making on **climate mitigation and adaptation strategies**.
- To ensure the accuracy and continuity of monitoring in the Arctic, the deployment of next-generation **remote sensing** technologies is essential. This monitoring includes the introduction of additional reliable, long-term instruments such as upgraded **microwave** sensors, cost-effective and environmentally friendly **drone** technologies, enhanced **spatial** observations in high-latitude regions through highly elliptical orbit (HEO) satellites, as well as improved on-site technologies, **cabled ocean observatories**.
- Marine environments will also benefit from innovations to improve deep sea operations from research vessels and to advance intelligent **robot** exploration to improve Autonomous Underwater Vehicle (AUV) technologies.
- **Open data management** practices have evolved as well and technologies are here to support FAIR and CARE principles
- All of this will require reliable, sustainable **power** year round

# Technology - Implementation

- Collect requirements from projects, infrastructure developments, then:
  - Consider re-use vs develop
  - Involve industry - buy off the shelf where possible (e.g., communications)
- Data Management:
  - Thematic, trusted data repositories exists: make use of them
  - Adopt standardized data formats and metadata protocols
  - Comply with FAIR and CARE principles

# Q&A

If you are dissatisfied why, what is missing?

What is the best way to implement this priority over the next 10 years?

Q1: What are the technological advances that YOU need to improve your research?

Q2: Trans-Arctic ocean cables will likely happen in the next few years and will bring about continuous, real-time monitoring capabilities. What data would you want to see collected?

# Cana Uluak Itchuaqiyaq, PhD

Intersection of research and Indigenous communities

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# Cana Uluak Itchuaqiyaq, PhD

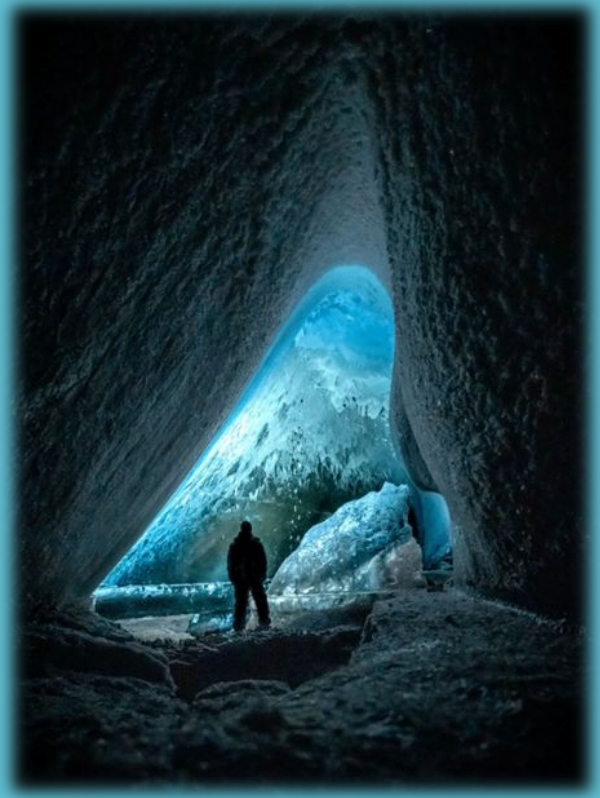
## Intersection of research and Indigenous communities


**Imperfect solution:** RPT7 will critically assess and refine our subteam goals to meaningfully incorporate the realities of Arctic Indigenous communities.

**Example:** Research teams need access to better water and sanitation options in remote sites (same with search & rescue, internet/broadband/satellite data, etc.), so do Arctic communities!

# Research Needs/Gaps across RPT 7

- Technological challenges: power supply, batteries, communication systems, development of ROVs and AUVs.
- Improve the ethical and environmental aspects of infrastructure.
- Limited spatial coverage of infrastructure.
- Limited in-situ observations & tools.
- Data gaps and lack of integration of observing systems.
- Expansion of remote and virtual access to research infrastructures.
- Expansion of remote sensing services.





Photos: Centre for Polar Studies archive

# Priority summary

- **Priority 1:** Sustainable Arctic Infrastructure and Logistics
- **Priority 2:** Continuity and development of distributed research infrastructure to provide sustainable observing platforms in support of societal and scientific needs.
- **Priority 3:** Enhance remote and virtual access to Research Infrastructure.
- **Priority 4:** Development and deployment of next-generation remote sensing technologies to strengthen Arctic climate, environmental, and ecosystem monitoring.

# Cross-cutting priorities across RPT7

1. Support equitable Indigenous leadership and participation
2. Harmonize and integrate data - equitable, FAIR, CARE
3. Long-term, stable, reliable funding
4. Address human infrastructure:
    a. Field safety needs
    b. Resources for mental and emotional health, code of conduct, reporting structures, communication cultures, trauma sensitivity
    c. Training - including Indigenous methodologies and ECR tools
    d. Foster equitable, sustainable and relationship centered engagement with local communities and Indigenous peoples. - ECR Summit

# Cross-cutting priorities across RPT7

5. International and equitable access & collaboration
   a. Shared inventories of observing assets
   b. Integrate existing research support across international boundaries
6. Facilitate networking of infrastructure operators to ensure safe, sustainable, and efficient operation of and access to infrastructure across international boundaries.

# Where we are now?

- We have been working with a library of documents and our inherent knowledge, but this can be biased to our own areas of expertise.
- Lens > RPT 7 is responsive to the requirements of other Research Priority Teams. We need your input on what you need to implement your priorities.
- Lens > Implementing RPT7 priorities can intersect with the needs of northern and Indigenous communities.

# Next Steps:

- Receive community feedback at ASSW 2025
  - Two tools: RPT 7 survey and ICARP survey
- Integrate work of other RPTs, white papers, etc.
- Other ideas - Open comment period for our draft final template?
- Submit a final report and sub-team reports.
  - Other products?


QR code for survey

**27 March 2025,** Boulder, Colorado, USA

Photos: Centre for Polar Studies archive

**Q1: How can national research infrastructures be better integrated into global access platforms?**

**Q2: What Arctic communities' infrastructure needs require additional research in the next 10 years?**

**Q3: How can data harmonization and interoperability be improved to ensure seamless logistics coordination in Arctic research?**

**Q4: What are the critical data gaps in Arctic observing systems, and how can they be addressed through integrated monitoring technologies?**

**Q5: Who should be responsible for implementing ICARP IV priorities into IPY 5?**

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# Research Priority Team 7: Technology, Infrastructure, Logistics, and Services

**Updated** QR code for the RPT survey,
or us this link to share [bit.ly/icarp-iv-rpt-7](bit.ly/icarp-iv-rpt-7)

**7 March 2025,** Boulder, Colorado, USA

Photos: Centre for Polar Studies archive