

Introduction

Change and Innovation in the Arctic

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The only constant is change. For the Arctic region, this seems both more and less true than other places. On the one hand, there has been incredible cultural continuity, with many traditions and practices carrying on much as they have for centuries or even millennia. At the same time, the past century has seen incredible change – both socially, with growing connectivity with ‘outside’ economies, cultures, systems and technologies; and environmentally, with global climate changes hitting the polar regions first and hardest.

These many changes both beget and require innovations – the adoption of new ideas, practices, methods or objects. Arctic peoples have shown significant flexibility, resilience and adaptability over the centuries; indeed surviving the region’s extreme conditions has required it (see e.g. *Arctic Yearbook 2014*). The adoption of gas-powered boats, hard-soled shoes, rifles and snowmobiles/snow machines, are more recent examples of disruptive technologies that have fundamentally altered northern societies.

Yet innovations in the 21st century – especially technological ones – are being developed at ever faster rates, a product of better education, better communications and the resultant rapid diffusion of ideas. There is a sense that the Arctic region is not yet fully enjoying the benefits of many technological innovations that urban, southern dwellers now take for granted: access to affordable high speed internet, links to global distribution systems, cheap air travel, or even roads. Many *existing* innovations, for example telehealth, food growing systems, and micro-sanitation, have yet to be adopted on a large scale in the North though their utility is obvious.

There is also a history of Arctic communities having had to endure the imposition of southern innovations or technologies that were geographically or culturally inappropriate for the region. Public housing stock, based on 1950s single family suburban dwellings, is one notable example, with the design, materials, and construction ill-suited for northern living. But there are many, many others. Food and energy systems based on importing goods from distant markets; municipal

infrastructure based on solutions to southern metropolises; health systems based on accessibility to tertiary care hospitals and specialists. All of these are clear examples where governments, and society, have simply extended southern solutions to the North with very little consideration for their appropriateness or sustainability.

Intellectually, this has often resulted in the entire North, as a global periphery, being framed in relation to, and as a poorer version of, the South: terrible internet, bad roads, no services. The gap in quality of living between North and South has indeed been growing in many parts of the Arctic region. Practically, it has imposed an unsustainable cost of adopting mainstream technologies and infrastructures in remote, off-grid, and cold locations. If the model is to build hundreds of kilometers of asphalt highways on permafrost, to maintain conventional airports and water treatment plants in communities of a few hundred people, or to ensure the affordability of imported vegetables in northern grocery stores, then we must also accept that many northern communities will be dependent on transfers from southern and central governments, thereby undermining self-determination - even as the gross production of many northern regions outweighs the amounts they are subsidized by southern capitals.

Could we imagine a different scenario, in four or five decades, where the rural North has (re)adopted unique systems and infrastructure that are appropriate and sustainable for northern realities? Or where Arctic communities have become so integrated into global food, transportation and economic systems that their Arcticness is incidental? Both of these seem preferable to the status quo. But which scenario do Northerners want to see realized?

Change Across Time

The Arctic has been subject to constant change over the centuries. Although we often think of the current, digital, age as a time of unprecedented social changes, the transition from a nomadic to a settled lifestyle that occurred through much of the Arctic in the 19th and 20th centuries, primarily as a result of colonization, arguably had a more significant impact. The introduction of the welfare state, universal primary education, and a wage economy introduced further, disruptive, changes.

Currently the Arctic, a unique and important part of the Earth system, is experiencing rapid environmental, social, economic and geopolitical changes. There are a variety of competing interests, images, visions, and actors at the local, regional, national and global levels, and many of the drivers shaping Arctic realities are exogenous (see e.g. *Arctic Yearbook 2013*). Despite many narrow, and often politicized, appraisals that climate change, in combination with globalization, will result in an Arctic race for resources and concomitant conflict, the post-Cold war Arctic has been, and is, peaceful. A high level of geopolitical stability has been established based on cooperation across borders by Arctic states and non-states actors, in particular the residents and civil societies of the region. This can provide a fruitful platform for connectivity and further innovations for the 'global' Arctic.

Indigenous vs Urban Arctic

It is common in the South to think of the Arctic as a homogenous, single region. But Arctic scholars, leaders and inhabitants have frequently articulated the existence of many Arctics – the presence of significant sub-regional variations in geography, culture and economy. In the context of innovation, there are few cleavages as significant as the rural-urban divide on the one hand, and the geopolitical (Nordic-Greenland/Russia/North America) divide on the other.

Cities in the Arctic, even though they may be small by global standards, generally have similar levels of services as their counterparts in the South; sometimes more, as they often serve as regional economic hubs and political centres. Many were developed in concert with the predominant local industry, often in the resource development sector, and have experienced significant immigration over the years. Some are aging, or in decline. But higher levels of education, mobility, and income have made the Arctic's urban residents much more integrated with global economic and social systems, and with reasonable access to the benefits attached to new, especially digital, technologies.

Rural Arctic residents by contrast, especially those living in remote or off-grid communities, have much more limited access to services and tools that are taken for granted in southern and urban areas. Affordable energy, clean water, internet and cellular coverage, and accessible building materials, are often prohibitively expensive or simply unobtainable based due to a lack of relevant human capital. Anything that requires an economy of scale is a challenge in the rural Arctic. It is also true that the vast majority of Arctic residents living in small, remote communities are Indigenous, and face additional structural barriers to fully enjoying the economic and social rights that are otherwise a hallmark of developed nations. While there is much promise for northern well-being attached to the digital age, including unprecedented connectivity to markets, information, entertainment, distance learning, telehealth, and social media, large swathes of the Arctic continue to have difficulty accessing it.

Similarly, it is illogical to lump the Euro-Arctic in with the rest of the region when discussing barriers and needs in technological innovation. Iceland and northern Finland, Norway and Sweden in particular have shown that it is possible to be northern and still succeed in the knowledge economy. The Nordic states enjoy virtually full internet coverage and smartphone saturation. Almost every community is connected to national road and energy systems. The kinds of innovations needed to improve quality of life are much more in line, and inextricably connected, with those of typical southern and urban communities. Whereas those, primarily Indigenous or ethnic minority, residents living in remote Arctic communities have very unique needs based on culture, geography and history. It is possible that the common denominator in Arctic innovation will not be the Arctic per se, but rather the need for elegant solutions to the challenges posed by (1) being off-grid; or (2) being cold. In this case, there should be, and needs to be, opportunity for collaboration with partners around the globe.

Innovation in the Arctic

There is often an implication that the Arctic is *lacking* or *deficient* in modern technologies, a close corollary to historical caricatures of the entire North as backwards or peripheral; a primitive space. It is not our intention to reinforce these stereotypes. Rather, we see opportunity for the Arctic, a region that has made significant progress over the past four decades in building novel and contextually-relevant political systems through devolution and self-determination, as on the cusp of an era in which northern specific and appropriate innovations are developed and adopted.

Much of this is happening already. Many of the articles in this volume detail the innovative use and adoption of ideas, systems and tools, from social media to digital storytelling to cross-border networking. But too many Arctic innovation initiatives are ad hoc, lack coordination and scale, or have insufficient human or financial capital. A regional innovation system – whereby the flow of knowledge and best practices happens seamlessly across communities, institutions and

entrepreneurs around the Arctic region – could address many otherwise insurmountable barriers: (1) *harsh environmental conditions*, which make many technologies adopted for mid-temperate climates, including batteries, mechanical parts, and many construction materials unreliable or inappropriate, and thus require northern-specific solutions; and (2) *economies of scale* to develop products and processes that address the unique needs of cold, sparse and off-grid communities, but which may need a larger market than the northern regions of individual states can provide to be feasible.

Innovation, Broadly Speaking

Although the discourse on innovation often focuses on technology, innovation comes in many forms, and Arctic societies have proven themselves to be innovative in many respects, particularly in the political sphere in the contemporary era. The elaboration of new models of decentralized and self-government beginning in the 1970s transformed northern politics and society, and while frequently emulated have yet to be matched elsewhere on the globe. Regional governance in the Arctic, built around unique institutions such as the Arctic Council (see *Arctic Yearbook 2016*), has been shown to be adaptable, innovative and most importantly successful over the past quarter century. The Arctic is home to many ‘firsts’ in global governance, and indeed to many ‘onlys’. These political innovations have provided a platform of regional networks across a variety of spheres, and relevant in the context of this year’s Yearbook theme, among academics and scientists, industry stakeholders, and militaries. This can pave the way for greater and more effective knowledge transfer in the future, with institutions such as the University of the Arctic with its Thematic Networks, the annual Arctic Circle Assembly as a global platform, and the Arctic Economic Council supporting SMEs which are already positioned to be conduits of Arctic innovations.

Over the past decade or so, climate change has accelerated the pace of diplomatic innovations by state and subnational actors to collectively address and coordinate (or anticipate) responses to increased human activity in northern waters. In 2008, the five Arctic coastal states (A5) jointly released the Ilulissat Declaration in which they listed the various areas of policy convergence that would benefit from increased international cooperation in the region, and formally agreed that the U.N. Convention on the Law of the Sea (UNCLOS) was the legal framework they would abide to in the future to preserve regional stability. In the spirit of that declaration, and under the auspices of the Arctic Council, the eight Arctic states signed three legally binding agreements to increase cooperation on maritime search and rescue in 2011, on marine oil pollution preparedness and response in 2013, and on international Arctic scientific cooperation in May 2017. On fisheries management, the A5 have been leading ongoing negotiations with other Arctic and non-Arctic states and organizations to obtain global political commitments to regulate fishing in the high seas portions of the Arctic Ocean by establishing a new legally binding international agreement to that end. Furthermore, international cooperation was also expanded to the level of maritime operations with the establishment, in 2015, of the Arctic Coast Guard Forum (ACGF), which was created by the Coast Guards of the eight Arctic states to share resources that increase international collaborative efficacy, capacity and capabilities in responding to the rising demands of search and rescue, and enforcing regulations related to environmental protection, fishing and vessel safety (see R. Pincus, [Arctic Yearbook 2015](#)). The ACGF held its first multilateral search and rescue exercise in Iceland, in September 2017 (with the participation of all Arctic countries in the actual

exercises, and others as observers.) Along those same lines, following the release of the Arctic Maritime Shipping Assessment in 2009, the Arctic Council states actively engaged in multilateral negotiations leading to the adoption, by the International Maritime Organization (IMO), of the International Code of Safety for Ships Operating in Polar Waters – or Polar Code –, which came into force in January 2017 (See L.W. Brigham, [Arctic Yearbook 2014](#)). Finally, beyond those innovative tools adopted to enhance maritime safety, additional creative political efforts were made in other areas to:

- Facilitate Arctic business-to-business activities and economic development with the establishment of the Arctic Economic Council in 2015;
- Enable Arctic security cooperation through the Northern Chief of Defence Conference (although suspended in 2013 as a result of the Russian-Ukraine crisis);
- Enhance locally-driven governance in the circumpolar north with the 2017 Arctic Mayors Declaration that lays out goals and priorities shared by Arctic peoples and mayors, and aims to promote and share pan-Arctic local best practices and lessons learned between northern communities, and;
- Increase Indigenous engagement in the Arctic Council's work through the Álgu Fund, an endowment that distributes funds provided by the Arctic states to the Permanent Participants of the Arctic Council, and a mechanism that facilitates collaborations on specific projects and initiatives (See J. Gamble, [Arctic Yearbook 2016](#)).

Building Capacity for Innovation

If the Arctic region boasts many examples of working collectively to develop new ideas, foster innovative practices, and address emerging problems and opportunities created by Arctic change, there is similarly a need to address some fundamental barriers.

One element of any strategy to improve the quality and uptake of new technologies in the Arctic region is to improve capacity in scientific and mathematic literacy. This would better position northerners to design new tools and applications as well as adapt southern/urban ones to northern requirements. Yet the historical context of education systems in the Arctic, specifically the imposition of Western standards and curriculum, makes this contentious. Should northern, and especially Indigenous, schools prioritize teaching Indigenous languages and culture, and on-the-land experiences; or should it immerse students in the STEM fields (Science, Technology, Engineering, Math) in preparation for wage employment? Can Western and traditional knowledge paradigms be complementary or are they fundamentally antithetical? Is there, or should there be, a middle ground?

A number of Arctic programs are already working to bridge those gaps, and have enjoyed success. One particularly good model is the Alaska Native Science and Engineering Program, a program founded in 1995 with the goal of supporting Alaska Native students on a pathway to science and engineering careers. Despite these bright spots, many Arctic communities still struggle to recruit qualified science and math teachers, and many northern students see Western math and scientific studies as foreign to their ways of living.

Arctic Yearbook 2017

The field of innovation studies began in earnest in the 1960s, and has seen significant growth in the past decade. However very little work has been done to apply that scholarship to an Arctic context. This year's Arctic Yearbook is an attempt to address this gap, with the nature of its articles an indication of the early direction of the field. We expect and hope that Arctic innovation studies will continue to develop in the future and are pleased to offer one of the first collections on the subject.

Section II: Thinking Arctic Innovation applies some of the more mainstream innovation concepts to an Arctic context. Pigford, Hickey & Klerkx examine innovation ecosystems as an approach for policy actors to enhance innovation linkages in the Canadian Arctic, and ask how scientific research activity can better contribute. Zbeed & Petrov examine Alaska's patent data to document the state's knowledge production geography and dynamics over the past thirty-five years, and to better understand whether and how a transition from a resource-based to a knowledge based economy is possible. Wheelersburg & Melvin summarize the existing national global level intellectual property rights that could be applied to, and provide better protection to, Traditional Knowledge. Murtagh & Collins explore the nature of creative capital among individuals in creative occupations based in two Nordic regions - Lapland in Finland and Västernorrland in Sweden - to assess its contribution to regional development and innovation. And Akimenko, Sarantou & Miettinen analyse the stories and narratives shared by artists in two workshops, held respectively in Rovaniemi and Murmansk, to understand how the qualities of life and work environments impact on art practices and identity construction.

Urbanization is increasingly linked to innovation and knowledge transfer. Suter et al describe the preliminary results of their efforts to produce an Arctic Urban Sustainability Index. Their project aims to help policymakers define and implement sustainability policies by measuring progress towards sustainability, compare across cities, and trace development over time. Kenny undertakes a brief investigation into the history of urban planning within the Arctic and outlines how urban planning in the region can constitute a form of resilience.

In *Section III: Creative Collaboration*, a number of examples of innovative partnerships, communities of practice, and knowledge networks – all fundamental to the creation and adoption of new ideas and processes – are highlighted. Huppert & Chuffart provide an analysis regional collaborations in the Arctic in the fields of education, health and infrastructure, to assess whether pan-Arctic collaborations in the Arctic are more viable than North-South collaborations. They find no signs of the pan-Arctic paradigm being more viable in the foreseeable future. Highet et al describe their project with the Fort McPherson *H. pylori* Project Planning Committee aimed at engaging youth and providing opportunities for capacity building. They articulate the need for scientific research in the region to generate meaningful and timely benefits for Indigenous communities in general, and Indigenous youth in particular. Engel et al discuss educator/research experiences in an environmental digital storytelling pilot project, #60above60, which took place within the larger research endeavor Partnerships for International Research and Education (PIRE): Promoting Urban Sustainability in the Arctic. The exchange sought to develop global competencies, environmental literacy, and promote student voices and agency. Lappalainen et al describe the Pan-Eurasian Experiment Program (PEEX), established in 2012 - a novel conceptual framework of research methods, infrastructures and procedures aiming to be a next-generation natural

sciences and socio-economic research initiative with impacts on future environmental, socio-economic and demographic development of the Arctic and boreal regions and China.

Section IV: Arctic Change & Innovation in Practice examines some real-life examples of attempts at change and innovation. Burtseva et al analyse current pediatric health care in Yakutia and conclude that a change to the current model is needed. These include the wider use of mobile diagnostic medical units, web-based information exchange (tele-consultation and medical reports), and the introduction of automated systems for preventive examination. Evdokimov et al assess the competitiveness of the local IT industry in northern Siberia, and suggest that growing competence in the IT field can help change notions that the High North is only a supplier of natural resources, and not a legitimate source of skilled labour. Ren & Rasmussen explore how the 2016 Arctic Winter Games held in Nuuk, Greenland, enacted possible futures through specific policies and practices pertinent to societal innovation in contemporary Greenland.

Section V: Resources and Development, and *Section VI: Governance and Development* return to the subject matter the Arctic Yearbook, and its host the UArctic Thematic Network on Geopolitics and Security, are best known for.

Dushkova, Krasovskaya & Evseev evaluate the development of the Northern Sea Route from the perspective of the impact further industrialization will have on the adjacent coastal zone ecosystems and northern residents, including economic, environmental and societal. Bouffard explores the differences and influences in Norwegian and Russian offshore oil-spill prevention policy in the Barents Sea, including how each state's national and economic strategic objectives translate into domestic policy, and how such influences are reflected in operational mandates and behavior. Zeuthen studies how country specific Chinese priorities and a sector specific political economy affect a Chinese enterprise investing in the Kvanefjeld project near Narsaq, Southern Greenland. Saunavaara considers Hokkaido as an example of a region in which development has been linked to new Arctic possibilities by both public and private actor, focusing on the Northern Sea Route and the submarine communications cables that pass through Arctic waters. Moscato examines both History Channel's reality television program 'Ice Road Truckers' and its Discovery Channel counterpart 'Deadliest Catch', including the programs' histories and their implicit or direct roles in influencing discourse about the Arctic and sub-Arctic's economy and ecology. Gauthier provides a systemic literature review on the economic development of Arctic navigation, focusing on the period between 2007-16. Liu provides an overall examination on the legal aspects of the Oslo Declaration, especially the arguments regarding the future of fisheries management in the High Seas portion of the Central Arctic Ocean, such as a Regional Fisheries Management Organization (RFMO) or Agreement (RFMA) as the interim measure, and the differences between the Declaration and international fisheries law. Finally, Sellheim, Zou & Inagaki examine some Arctic-specific hard and soft legal instruments and determines the degree to which the Arctic legal space serves as a stage for the construction of a 'better world' or 'Arctopia'.

These scholarly contributions are complemented by commentaries and briefing notes on various Arctic innovations and initiatives, as well as the events and phenomena that captured our attention in 2017. We are grateful to the experts and policy-makers who contributed their expertise and insight in these shorter pieces.

Conclusions

It is often said that necessity is the mother of invention. A collective desire to address the many societal, political, and environmental needs in the Arctic region must now lead to a collective strategy to do so. The Arctic can be a victim of change, or it can be a model - not only of resilience to that which the region's inhabitants cannot control, but for capitalizing on the opportunities that change can bring. The Arctic can be a region characterized by innovation.

We have attempted in this year's Arctic Yearbook to put a spotlight on innovation as defined in an Arctic context, and to begin a conversation on whether, and how, Arctic communities can be innovative together. A solid foundation for adopting new and innovative processes and institutions in the region has already been established in the political sphere. There is much remaining opportunity to embrace transformative technologies that have an impact on Arctic residents' daily life and well-being.