ABSTRACTS AND SPEAKER BIOS

A History of Arctic Infrastructure

Philip Wight

The history of Arctic infrastructure remains a relatively understudied and undertheorized field. This is particularly true when one accounts for the enormous volumes of primary source material that have been generated by corporations and governments regarding the planned or realized construction of hundreds of Arctic infrastructure projects. The production of paperwork, data, and analysis has been a key aspect of 20th Century corporate and governmental bureaucracies. Historians and social scientists have just begun to access these archives and offer updated interpretations concerning the full intentions and impact of Arctic infrastructures. This presentation will introduce ten high-level ideas and provocations to stimulate further discussion about the history and further study of Arctic infrastructure. This material is not yet a coherent research project, or even the early stages of a future research project, but rather is drawn from multiple completed and projects in process. Humans are an infrastructural species which extensively modify environments from the Arctic to the tropics. The construction of infrastructures in the far north dates back to the earliest human inhabitants and has always been central to human thriving in the far North. Amongst the many vital human needs and associated infrastructures, transportation systems and mobility were paramount. Access, and lack of access, define Alaska and much of the far North. This was true with Umiaks and dog teams thousands of years ago, and it is true today with a wide range of practices from subsistence to natural resource extraction to the preservation of wild landscapes. The ability to move across the land and access resources is paramount and is the essence of northern life. Most of the existing social science literature does not properly recognize or account for the deeper historical roots of large-scale Arctic infrastructure development, especially in Greenland, Alaska, Canada, and Iceland. Scholars typically associate infrastructural development with the Cold War (1945-1991) and its profound impacts. Yet it was World War Two, not the Cold War, which was the foundational event for the widespread development of the Arctic. Scholars need to pay closer attention to this first generation of development—from hydrocarbon pipelines, to oil extraction, and airfield development—to understand the path dependence and legacy of Arctic infrastructure.

Social Science (Anthropology) Perspectives on Arctic Infrastructure

Olga Povoroznyuk and Peter Schweitzer

It has been only recently that the social sciences and humanities have engaged with infrastructure in earnest. Social anthropology was a latecomer to infrastructure studies, but more recently there has been a veritable explosion of anthropological literature on the subject. A main thrust of anthropological research has been conducted to show how infrastructures become terrains for political engagement. Thus, social anthropology explores infrastructure as political and modernisation projects and social agents. It focuses on infrastructure imaginaries, promises and process of (mal)functioning, ruination, and reconstruction to investigate cultural dynamics and social conflicts and movements. Social scientists and anthropologists focusing on Arctic infrastructure have been studying entanglements between local and Indigenous communities and infrastructure in the contexts of rapid climate change, remoteness, and resource extaction. While there is a long history of social impact assessments of development projects, we argue that social anthropologists, and other social scientists working in the Arctic, should focus more on social configurations of privileges and ineqalities resulting from the affordances and "fly-over" effects of infrastructure, as well as on different forms of knowledge produced by infrastructure. Drawing on examples from our own and other research projects, we provide an overview of social science and anthropological research on Arctic infrastructure in the recent decade. Furthermore, we identify research gaps and future avenues for social science and anthropological inquiries in infrastructure in the arctic and subarctic regions.

Permafrost Degradation and Infrastructure Costs

Dmitry Streletskiy

The Arctic climate is warming three to four times faster than the global average. The majority of building foundations in permafrost regions depend on the mechanical strength or bearing capacity of permafrost. This capacity is decreasing as a result of permafrost temperature increasing, making these structures on permafrost unstable. Increase in active layer thickness decreases the contact of piling foundations with permafrost, which promotes heaving, and increases area of buried foundation contact with the active geochemical environment promoting cryogenic weathering and corrosion of foundations. Increasing ALT in ice-rich permafrost may result in ground ice melt and consolidation, leading to thaw subsidence. Such subsidence may have direct negative consequences for linear infrastructure, such as roads, railroads, pipelines and airstrips, but also affect buildings and structures. Under projected climate warming the cost of permafrost degradation to infrastructure is 276 bln USD under a high emission scenario by 2060. By not accounting for rapidly changing climatic conditions during the design and construction of infrastructure, planners may underestimate the ability of permafrost to support infrastructure. Lack of adequate geotechnical permafrost monitoring, lack of dedicated departments or units tasked with building a legal framework around permafrost, and a lack of climate change integration into construction principles and regulations may amplify the costs of permafrost degradation. Adapting the existing infrastructure will require significant investment at local, municipal and state levels. It takes all hands from federal, state, and municipal or community level as well as private sector to establish the legal framework of building and maintaining resilient infrastructure on permafrost.

Engineering Perspective on Gaps for Future Arctic Energy Infrastructure

Magnus de Witt

Several upcoming topics in Arctic engineering are related to the rapid change of the Arctic climate. Thawing permafrost impacts the foundation of engineered infrastructure. This can have a significant impact on the future of the energy sector in the Arctic. Over time, the focus on energy research in the Arctic has changed from energy extraction to secure energy supply. In modern Arctic communities, a secure, uninterrupted, and affordable supply is essential to support modern living. Looking into the future of the Arctic energy supply, it can be seen that these points will grow in importance. The impact of climate change can make it advisable to prioritize local energy sources to lower the impact of external factors on energy security in the Arctic. Local energy resources can help cut down the supply chain to reduce global economics' influence on the communities' energy supply. On a global level, a growing interest in the extraction of hydrocarbons can be seen. On the one hand, global warming makes the Arctic more accessible for large-scale projects. On the other hand, thawing permafrost will impact Arctic infrastructure, which could be in terms of energy ranging from drilling platforms, terminals, and pipelines. On a community level, the impacts can be related to the transmission system over the generation and up to the energy storage facilities. For future research in the field of energy engineering in the Arctic, the following points could be of interest: security (responsive construction to a changing (thawing) ground; development of new (local/global) resources); innovation (new ways to finance the development of new resources, new technology development, adaptation of existing technologies to Arctic climate conditions); the social (interaction of people with energy, affordability of energy).

Permafrost Management in Arctic Urban Design

Matthew Jull and Leena Cho

This research explores an integrated approach to urban design in Arctic regions, focusing on the role of snow and meltwater management in preserving ice-rich permafrost and maintaining the stability of buildings and infrastructure. Centered on Utqiaġvik, Alaska, the study addresses climate-driven challenges such as increased precipitation, meltwater runoff, and permafrost thaw. While snow insulates the ground in winter, excessive accumulation can inhibit permafrost cooling, and meltwater retention can elevate soil temperatures and destabilize ground conditions. Effective snow and water management is therefore critical for sustaining thermal balance. The project’s first phase used environmental sensors and satellite imagery to map thaw patterns and ground degradation. The second phase incorporated fieldwork and stakeholder interviews to validate findings and develop site-specific strategies. Central to this approach, architecture and landscape architecture design studios taught at the University of Virginia School of Architecture analyzed the relationship between built infrastructure, snow dynamics, topography, and drainage systems. These studios - which served as a vehicle for co-produced scenario planning for the built environment - developed actionable design outcomes to mitigate the destabilizing effects of permafrost degradation. A key strength of this research was its close collaboration with local organizations, including the North Slope Borough, Barrow Utilities & Electric Cooperative (BUECI), Ukpeaġvik Iñupiat Corporation (UIC), and the City of Utqiaġvik. These partnerships ensured that research outcomes are aligned with operational practices and local knowledge. Preliminary findings identified citywide drainage planning and snow management as essential tools for mitigating permafrost degradation. Urban modifications such as from roads, gravel pads, and utility corridors significantly influence the thermal performance of the ground, especially where permafrost is rich in ice. The research proposes several holistic design strategies to reduce snow drifting and meltwater pooling. These approaches, paired with ongoing monitoring, offer a scalable framework for supporting Arctic communities confronting the impacts of climate change.

Community Perspectives on Infrastructure Futures: Research Priorities

Vera Kuklina and Diana Khaziakhmetova

The Arctic is experiencing unprecedented climate-induced damages, including permafrost thaw, coastal erosion, sea level rise, and extreme weather events that threaten critical infrastructure. These challenges necessitate a fundamental shift in infrastructure planning—moving beyond reactive responses toward proactive, community-centered, and climate-resilient approaches. The RCN: Co-creating Research for Just Arctic Future Infrastructure Transformations, Resilience, and Adaptation (CRAFT) network was created to bridge knowledge gaps and foster collaboration among Arctic researchers, Indigenous and local communities, and other key stakeholders across Alaska, Canada, Greenland, and Norway. Through interdisciplinary engagement, the project explores how infrastructure can be designed to enhance resilience, sustainability, and equity. One of the most significant findings from our work so far is that focusing on the process of engagement and co-production is challenging but crucial. For researchers, it is difficult to shift away from traditional, outcome-oriented research models toward a process-driven approach. Co-production takes time, requires deep relationship-building, and often does not result in immediate academic publications. Instead, its most valuable outcomes lie in fostering trust, building long-term partnerships, and ensuring that research efforts reflect community priorities. Developing collaborative research networks allows to connect Arctic scientists, engineers, policymakers, and Indigenous knowledge holders. However, it is only the first step in knowledge co-production. The success of its implementation depends on the meaningful engagement of communities and stakeholders at each step. Such participatory decision-making processes give communities greater agency in shaping infrastructure projects and making sure they are developed in accordance with local contexts. Moreover, knowledgesharing platforms should be prioritized in the future to provide decision-makers with evidence-based insights on equitable infrastructure solutions.

Mapping the Visible, Understanding the Invisible: Remote Sensing and Qualitative Methods in Arctic Infrastructure Studies

Annett Bartsch and Alexandra Meyer

This paper reviews methodological approaches to the study of Arctic infrastructure, and highlights the complementary roles of remote sensing and qualitative methods. Arctic infrastructure extends beyond built environments to include natural elements such as rivers, permafrost, and sea ice, which are observable through remote sensing techniques. Remote sensing can support the collection of spatially consistent and up to date information on the expanse of the build environment. However, only certain types of infrastructure can be captured due to the limitation to visible features distinct from their surroundings. Environmental change can be observed in addition and applied in geospatial analyses. Specifically AI techniques have been demonstrated of added value for road and building detection although the limitation of scale currently remains. Only larger objects can be monitored on pan-Arctic scales. High detail investigations as required to tackle settlement specific analyses are still limited to smaller areas, but recent developments in processing capabilities and data availability are promising. Qualitative methods provide crucial insights into the socio-cultural dimensions of Arctic infrastructure. Ethnographic fieldwork, observations, interviews and focus groups reveal local perspectives and community priorities on infrastructure. Participatory approaches are central, emphasizing the incorporation of local knowledge. There are calls for increased engagement with holistic, integrative and collaborative approaches, and an emergence of specific methodological tools including arts-based and visual methods and participatory mapping. Yet, significant gaps remain in effectively bridging local and scientific knowledge, top-down and bottom-up approaches, as well as different disciplinary perspectives. We highlight the need for interdisciplinary approaches that bridge top-down geospatial analyses with bottom-up perspectives. Combining remote sensing data with qualitative insights and local knowledge allows for improved risk assessments, development planning, and a deeper understanding of infrastructure in Arctic environments. By acknowledging the "epistemological plurality" inherent in Arctic research, an integrative approach can better address the region's complex infrastructural and environmental challenges.

SPEAKER BIOS

Bartsch, Annett obtained her doctorate from the University of Reading, UK, in 2004 for her studies on periglacial geomorphology and remote sensing in northern Norway and Sweden. She obtained her venia docendi in applied remote sensing from Vienna University of Technology, Austria in 2011. She is managing director of the earth observation company b.geos and working group leader at the Austrian Polar Research Institute. She is one of two Austrian representatives to the Terrestrial Working Group (TWG) of the International Arctic Science Committee (IASC). She is author/co-author of more than 100 peer-reviewed papers and book chapters, mostly on land surface remote sensing across the Arctic, including monitoring of snow properties, permafrost features, wetlands, lakes and the human footprint.

Cho, **Leena** is an Associate Professor in the Department of Landscape Architecture at the University of Virginia School of Architecture, and Co-Director of Arctic Design Group (ADG). Her research focuses on design agencies of arctic environments and scientific practices that produce emerging forms of cultural landscapes in the age of climate change. Integrating wide-ranging disciplines and modes of collaboration into the design research, her work spans from Alaska to Siberia and has been funded by numerous cultural and governmental organizations. In parallel with her design offices, Kutonotuk and TempAgency, her work has been published and exhibited internationally.

de Witt, Magnus is a Research Assistant Professor at ACEP. His research at ACEP focuses on the energy transition in Alaska, Railbelt, and remote communities. The research includes energy security, policy, economics, and implementation methods. A particular interest is how renewables can support affordable and secure energy in Arctic communities. Dr. de Witt has travelled across the Arctic to conduct field studies and see the energy situation firsthand.

Jull, Matthew is an Associate Professor of Architecture at the UVA School of Architecture, co-director of the Arctic Design Group (ADG), and a principal of the design practice KUTONOTUK. With a background in geophysics, Dr. Jull's research explores the design of buildings, cities, and infrastructure within the frame of climate change, extreme environments, emergent technologies, and the increasing friction between the built environment and the forces shaping our planet. Funded by grants from the National Science Foundation, among others, Jull is involved in collaborations throughout the Arctic region, and his work has been featured in numerous publications, exhibitions, and symposia.

Khaziakhmetova, Diana is a doctoral student in the School of Geography, Development, and Environment at the University of Arizona. Originally from Kazan, Russia, she is of Tatar, Udmurt, Russian, and Ukrainian heritage. Diana earned her Bachelor's degree in Law and a Master's degree in Urban Planning from the Higher School of Economics in Moscow, followed by a second Master's in Geography from George Washington University in Washington, DC. Her research focuses on urban geography with emphasis on Indigenous communities in the Arctic and is especially concerned with the use of public spaces, urban resilience, and climate justice. Diana aims to advance urban geography by prioritizing the decolonization of urban spaces, policies, and research methodologies, empowering Indigenous communities, and integrating artful community engagement into research.

Kuklina, Vera is a research professor at the Department of Geography and Environment, George Washington University, and a member of the IASC Social and Human Working Group. Research interests include the urbanization of Indigenous people, traditional land use, socio-ecological systems, cultural geographies of infrastructure, and remoteness.

Meyer, Alexandra is a postdoctoral researcher at the Department for Social and Cultural Anthropology, University of Vienna, Austria and a senior researcher at the Western Norway Research Institute. She works on local human-environment relations in the context of climate change and adaptation, permafrost thaw, cultural heritage, and (transport) infrastructure with a regional focus on Svalbard and keen interest in transdisciplinary and participatory approaches. She is a founding board member of the Svalbard Social Science Initiative (SSSI) and is one of two Austrian representatives to the Social and Human Working Group (SHWG) of the International Arctic Science Committee (IASC).

Povoroznyuk, Olga is a Postdoctoral Researcher and Lecturer at the Department for Social and Cultural Anthropology, University of Vienna (UV). She represents Austria in the IASC Social and Human Working Group and is a co-chair of the IASC Research Initiative RATIC and a member of the Austrian Polar Research Institute. Her interests include infrastructure and development, identity and indigeneity, postsocialism and postcolonialism, environmental change, biocultural heritage, sustainability in Siberia, Alaska, and Northern Norway. She has been part of several EU-funded projects and is currently leading a UV part of a Belmont Forum Project about climate adaptation in Arctic cities.

Schweitzer, Peter is Professor at the Department of Social and Cultural Anthropology at the University of Vienna and Professor Emeritus at the University of Alaska Fairbanks. His theoretical interests range from the history of anthropology to human-environmental interactions, including the social entanglements with infrastructure and climate change; his regional focus is the circumpolar North. He has published widely on these issues and is currently leading the ERC Advanced Grant *InfraNorth*.

Streletskiy, Dmitry (Dima) is a Professor of Geography and International Affairs at the George Washington University. His research is focused on understanding diverse impacts of climate change on ecosystems, population and overall sustainability of the Arctic regions. Streletskiy is the Past President of the United States Permafrost Association and the Chair of Global Terrestrial Network for Permafrost. He is an undergraduate advisor for Environmental and Sustainability

Sciences and teaches graduate and undergraduate courses in areas of geospatial techniques, physical geography, climate change, and regional geography classes focused on Arctic and Russia.

Wight, Philip is an Assistant Professor of History and Arctic & Northern Studies at the University of Alaska Fairbanks. He is an environmental historian, with a focus on infrastructure, mobility, and climate. Dr. Wight's research ranges from the environmental history of the Trans-Alaska Pipeline System to the history of nuclear power and electrification in the far north, to the legal foundations for dismantling fossil infrastructure in the Arctic. He is currently working on a book manuscript entitled, *Arctic Artery: The Trans-Alaska Pipeline System and the World it Made.*