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THESIS

**A COOPERATIVE SPACE STRATEGY FOR THE
ARCTIC: POLICY, STRATEGY AND OPERATIONAL
ASPECTS OF POLAR GREAT POWER COMPETITION**

by

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June 2021

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STRATEGY AND OPERATIONAL ASPECTS OF POLAR GREAT POWER
COMPETITION**

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ABSTRACT

The Arctic is an emerging theater of strategic importance. Opening sea lines of communication and increased access to Arctic resources are forcing U.S. strategic planners and decision makers to address regional challenges. The reemergence of polar great power competition, coupled with rapid climate change, has drastically altered the strategic demand for space capabilities within the region. This thesis explored how the United States might benefit from a cooperative space strategy for the Arctic and whether the United States must build collaborative space capacity within the Arctic to achieve its stated strategic objectives within the region. While U.S. strategists have presented a clear case for strategic engagement and cooperation in the High North, the United States currently lacks a comprehensive Arctic strategy for space that encompasses the challenges, opportunities, and existing capabilities and gaps of U.S. allies and partners in the region related to the space domain. Although U.S. Arctic strategies have consistently highlighted the fundamental necessity to enhance Arctic domain awareness and the political and geostrategic challenges that the United States faces within the Arctic region, these strategies lack an overarching framework for allied and partner space cooperation to achieve these effects. This thesis investigates how the United States builds allied and partner space cooperation in the Arctic to reinforce U.S. strategic interests in the region.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAUsat	Aalborg University Satellite
ACE	Arctic Collaborative Environment
ADAC	Arctic Domain Awareness Center
ADS-B	Automatic Dependent Surveillance-Broadcast
AEPS	Arctic Environmental Protection Strategy
AFB	Air Force Base
AFNORTH	Allied Forces Northern Europe
AFRL	Air Force Research Laboratory
AFSCN	Air Force Satellite Control Network
AIS	Automatic Identification Signals
ARPA	Arctic Research and Policy Act
ARR	Andøya Rocket Range
ASC	Andøya Space Center
ASM	Arctic Science Ministerial
BMD	Ballistic Missile Defense
BMEWS	Ballistic Missile Early Warning System
C3ISR	Command, Control, Communications, Intelligence, Surveillance, and Reconnaissance
CBT	Cross Border Training
COPUOS	Committee on the Peaceful Uses of Outer Space
CRS	Congressional Research Service
CSDP	Common Security and Defence Policy
CSIS	Center for Strategic and International Studies
DALO	Defence Acquisition and Logistics Organization
DCDA	Defence Command Denmark
DEW	Distant Early Warning
DHS	Department of Homeland Security
DMA	Danish Maritime Authority
DNSC	Danish National Space Center
DOD	Department of Defense
DSRI	Danish Space Research Institute
DTU Space	National Space Institute at the Technical University of Denmark
EASP	Esrang Andøya Special Project
EC	European Commission
EEZ	Exclusive Economic Zone
EISCAT	European Incoherent Scatter Scientific Association
ELDO	European Launcher Development Organisation
EPS	Enhanced Polar System
EPS-R	Enhanced Polar System-Recapitalization

ESA	European Space Agency
ESP	ESRANGE Special Project
ESRANGE	European Space and Sounding Rocket Range
ESRO	European Space Research Organisation
EU	European Union
FFI	Norwegian Defence Research Establishment
GAO	Government Accountability Office
GCC	Geographic Combatant Command
GDP	Gross Domestic Product
GEO	Geosynchronous Earth Orbit
GIUK-N	Greenland, Iceland, United Kingdom - Norway
GGNSS	Galileo Global Navigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HEO	Highly Elliptical Orbit
IAMD	Integrated Air and Missile Defense
IARPC	Interagency Arctic Research Policy Committee
IC	Intelligence Community
ICC	Interorganizational Collaborative Capacity
ICE-PPR	International Cooperative Engagement Program for Polar Research
IFTA	Institute of Theoretical Astrophysics
Inmarsat	International Maritime Satellite Organization
INTAROS	Integrated Arctic Observing System
ISIS	International Satellite for Ionospheric Studies
ISR	Intelligence, Surveillance, and Reconnaissance
ITAR	International Traffic in Arms Regulations
JACO	Joint Arctic Command
JCTD	Joint Capability Technology Demonstration
KSAT	Kongsberg Satellite Services AS
LEO	Low-Earth Orbit
MARCOM	Maritime Command
MTMD	Maritime Theater Missile Defense
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NDRE	Norwegian Defence Research Establishment
NDS	National Defense Strategy
NEO	Near-Earth Object
NIS	Norwegian Intelligence Service
NORAD	North American Aerospace Defense Command
NORDEFECO	Nordic Defence Cooperation
NOSA	Norwegian Space Agency
NPS	Naval Postgraduate School

NSC	Norwegian Space Centre
NSDM	National Security Decision Memorandum
NSF	National Science Foundation
NSI	National Space Institute
NSP	National Space Policy
NSPD	National Security Presidential Directive
NSR	Northern Sea Route
NSSS	National Security Space Strategy
NSTC	National Science and Technology Council
NTA	Norwegian Telecommunication Administration
NTNF	Royal Norwegian Council for Scientific and Industrial Research
NWS	North Warning System
OECD	Organisation for Economic Cooperation and Development
OES	Bureau of Oceans and International Environmental and Scientific Affairs
OPA	Office of Ocean and Polar Affairs
PNT	Positioning, Navigation, and Timing
RAF	Royal Air Force
RCN	Research Council of Norway
SAR	Search and Rescue
SAR	Synthetic Aperture Radar
SDCA	Supplementary Defense Cooperation Agreement
SIOS	Svalbard Integrated Arctic Earth Observing System
SMART-L	Signal Multibeam Acquisition Radar for Targeting L-Band
SofSP	Surveillance of Space Project
SOPS	Space Operations Squadron
SSA	Space Situational Awareness
SSAG	Space Systems Academic Group
SSN	Space Surveillance Network
SST	Space Surveillance and Tracking
STEM	Science, Technology, Engineering, and Mathematics
STM	Space Traffic Management
STRATCOM COE	Strategic Communications Centre of Excellence
SWS	Space Warning Squadron
TT&C	Telemetry, Tracking, and Command
UEWR	Upgraded Early Warning Radar
UHF	Ultra High Frequency
UK	United Kingdom
UNOOSA	United Nations Office for Outer Space Affairs
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
USML	United States Munitions List

USNORTHCOM	U.S. Northern Command
USSF	U.S. Space Force
USSPACECOM	U.S. Space Command
USSTRATCOM	U.S. Strategic Command
VDES	VHS Data Exchange System
XDR	Extended Data Rate

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¹ Tish Rabe, *There’s No Place Like Space!* (New York: Random House, 2009).

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I. INTRODUCTION

A. MAJOR RESEARCH QUESTION

This thesis seeks to answer how the United States might benefit from a cooperative space strategy for the Arctic and whether the United States must build space collaborative capacity within the Arctic to achieve its stated strategic objectives within the region in an era of polar great power competition. While U.S. strategists have presented a clear case for strategic engagement and cooperation in the High North, the United States currently lacks a comprehensive Arctic strategy for space that encompasses the challenges, opportunities, and existing capabilities and gaps of U.S. allies and partners in the region related to the space domain. Although U.S. Arctic strategies have consistently highlighted the fundamental necessity to enhance Arctic domain awareness and the political and geostrategic challenges that the United States faces within the Arctic region, these strategies lack an overarching framework for allied and partner space cooperation to achieve these effects.¹ This thesis investigates how the United States builds allied and partner space cooperation in the Arctic to reinforce U.S. strategic interests in the region.

To capture the full scale and scope of Arctic geopolitical and strategic issues and opportunities is well beyond the scope of this thesis. Rather, its purpose is to analyze how space operations and associated capabilities contribute to achieving desired national strategic objectives outlined in Arctic policies, and examine how the United States can benefit from coalition operations in space through Arctic-state bilateral cooperation, Arctic regional multilateral cooperation, or Arctic-centric intergovernmental cooperation inclusive of non-Arctic actors. Additionally, this thesis seeks to understand the geopolitical challenges to space operations within the Arctic both terrestrially and within the space domain and analyze Arctic allied and partner space capabilities through comparative case studies that seek to understand their potential motivations or apprehension to future collaborative space initiatives.

¹ White House, *National Strategy for the Arctic Region* (Washington, DC: White House, 2013), 6, https://obamawhitehouse.archives.gov/sites/default/files/docs/nat_arctic_strategy.pdf.

The policy recommendations at the conclusion of this thesis are intended to inform the Office of Ocean and Polar Affairs (OPA)² and Office of Space Affairs³ within the Department of State's Bureau of Oceans and International Environmental and Scientific Affairs (OES), U.S. Northern Command (USNORTHCOM) as the Department of Defense's (DOD) Arctic Capability Advocate, the U.S. Coast Guard (USCG) as the lead agency for homeland security in the Arctic, U.S. Space Command (USSPACECOM) as the DOD's geographic combatant command for space, and the U.S. Space Force (USSF) as the DOD's "military service that organizes, trains, and equips space forces in order to protect U.S. and allied interests in space and to provide space capabilities to the joint force."⁴ This research is significant due to the increasing political and geostrategic value of the Arctic as an arena for polar great power competition and homeland defense. The goal of this research is to form the basis of a new, competitive, and realistic United States national space strategy for the Arctic.

B. SIGNIFICANCE OF THE RESEARCH QUESTION

The Defense Space Strategy from 2020 clearly articulates that the current "U.S. defense space enterprise was not built for the current strategic environment."⁵ The Arctic is an emerging theater of strategic importance. Opening sea lines of communication and increased access to Arctic resources are forcing U.S. strategic planners and decision makers to address regional challenges. The Arctic's unique operating environment and harsh conditions require innovative solutions to address the emerging challenges and

² The U.S. Department of State website states, "[The Office of Ocean and Polar Affairs (OPA)] is responsible for formulating and implementing U.S. policy on international issues concerning the ocean, the Arctic, and the Antarctic (Department of State, n.d.)."

³ The U.S. Department of State website states, "The Office of Space Affairs carries out diplomatic and public diplomacy efforts to strengthen American leadership in space exploration, applications, and commercialization by increasing understanding of, and support for, U.S. national space policies and programs and to encourage the foreign use of U.S. space capabilities, systems, and services (Department of State, n.d.)."

⁴ "United States Space Force Mission," U.S. Space Force, accessed March 14, 2021, <https://www.spaceforce.mil/About-Us/About-Space-Force/Mission/>.

⁵ Department of Defense, *Defense Space Strategy Summary* (Washington, DC: Department of Defense, 2020), 3, https://media.defense.gov/2020/Jun/17/2002317391/-1/-1/1/2020_DEFENSE_SPACE_STRATEGY_SUMMARY.PDF.

opportunities.⁶ The reemergence of polar great power competition, coupled with rapid climate change, has drastically reinvigorated the strategic demand for space capabilities in the region. The harsh Arctic operating environment requires national security planners to develop greater capabilities and capacity to, from, and through the space domain. Space operations and associated capabilities are uniquely qualified to meet operating challenges in the Arctic with their reduced physical footprint, large coverage areas, and ability to span across international boundaries. Furthermore, these space capabilities directly address key U.S. strategic capability gaps within the Arctic by enhancing multi-domain awareness, facilitating command, control, communications, intelligence, surveillance, and reconnaissance (C3ISR), and providing increased missile defense and early-warning capacity within the region.⁷

The Arctic is a geostrategic region increasingly important to U.S. economic prosperity and national security. Opening to insecurity and opportunity, the Arctic is experiencing dynamic change in the physical, economic, and security environments. Rapid climate change and a reduction in sea ice coverage is increasing access to new maritime lines of communication and expanding competition for resources within the region. A reemerging Russian military presence and rising Chinese economic investment in the region is witnessing a rise in tensions and a reduction in U.S. geopolitical influence. Consequently, the post-Cold War era of *Arctic exceptionalism* characterized by peace and stability and largely focused on scientific research and exploration is now being transformed into an era characterized by significant environmental, security, and economic geostrategic challenges.⁸

⁶ This thesis uses the definition of the Arctic codified in U.S. Code, Title 15, Commerce and Trade, Chapter 67, Arctic Research and Policy, Section 4111 (15 U.S.C. § 4111), which designates the Arctic as “all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, and Chukchi Seas; and the Aleutian chain.”

⁷ Department of the Air Force, *The Department of the Air Force Arctic Strategy* (Washington, DC: Department of the Air Force, 2020), 8, <https://www.af.mil/Portals/1/documents/2020SAF/July/ArcticStrategy.pdf>.

⁸ “Space for the Arctic,” The European Space Agency, last modified March 15, 2012, https://www.esa.int/Applications/Observing_the_Earth/Space_for_our_climate/Space_for_the_Arctic.

The United States, by virtue of Alaska, is an Arctic nation with “substantial political, economic, energy, environmental, and other interests in the region.”⁹ Despite the strategic importance of the Arctic to U.S. national interests, there remain significant capability gaps related to communications, multi-domain awareness, access, and presence within the region. According to a Government Accountability Office (GAO) assessment of the DOD’s 2011 Arctic Report, the “DOD has identified Arctic capability gaps, but lacks a comprehensive approach to addressing Arctic capabilities.”¹⁰ It goes on to say,

While DOD’s Arctic Report assessed a relatively low level of threat in the Arctic region, it noted three capability gaps that have the potential to hamper Arctic operations. These gaps include (1) *limited communications*, such as degraded high-frequency radio signals in latitudes above 70°N because of magnetic and solar phenomena; (2) *degraded global positioning system performance* that could affect missions that require precision navigation, such as search and rescue; and (3) *limited awareness across all domains* in the Arctic because of distances, limited presence, and the harsh environment [emphasis added].¹¹

Other key challenges identified within the report include shortfalls in ice and weather reporting and forecasting, and limitations in C3ISR due to a lack of available ground, sea, air, and space assets. These complex regional problems require more than a nationalistic approach to address these critical capability needs. The GAO assessment concludes that “addressing near-term gaps is essential for [the] DOD to have the key enabling capabilities it needs to communicate, navigate, and maintain awareness of activity in the region.”¹² It also notes that “the long lead time associated with capability development, particularly procurement of space-based assets and ships, requires a

⁹ Ronald O’Rourke et al., *Changes in the Arctic: Background and Issues for Congress*, CRS Report No. R41153 (Washington, DC: Congressional Research Service, 2021), 1, <https://fas.org/sgp/crs/misc/R41153.pdf>.

¹⁰ John Pendleton, *Arctic Capabilities: DOD Addressed Many Specified Reporting Elements in Its 2011 Arctic Report but Should Take Steps to Meet Near- and Long-term Needs*, GAO-12-180 (Washington, DC: Government Accountability Office, 2012), 17, <https://apps.dtic.mil/dtic/tr/fulltext/u2/a554921.pdf>.

¹¹ Pendleton, *Arctic Capabilities*, 17.

¹² Pendleton, 21.

deliberate risk-based investment strategy” and cited the “importance of collaboration to develop Arctic capabilities.”¹³

Although multiple studies and policy statements have identified and reemphasized the same challenges of the 2011 Arctic Report over the past decade, identified capability gaps have primarily remained underfunded and unresolved. The Arctic remains an austere operating environment with extreme environmental and technical challenges and limited existing capabilities to respond to increasing threats within the region. This thesis assumes that the lack of progress on key space capabilities and developmental concepts associated to the Arctic region can be attributed to the propensity of most strategic planners to view space security and space capability development concepts from a purely nationalistic perspective. As argued by Naval Postgraduate School (NPS) professor and space policy expert Dr. James Clay Moltz, the United States instead should be fostering the concept of an allied space “network.” He goes on to say that “by spreading capabilities among allies in space through the creation of inter-operable, redundant networks of satellites, including in the military sector, space-based partnerships could reduce costs, lessen vulnerability, and raise the challenges facing would-be attackers.”¹⁴ He also notes that “given the tightening financial situation in most countries today and in the United States itself, pooling resources may be the most effective means of building new capabilities.”¹⁵

Although current space policy strategies are not region specific due to the cross-boundary nature of the space domain, this thesis investigates how a national comprehensive space cooperation strategy specific to the Arctic region would address Arctic-specific challenges with international partners that have vested interests in Arctic affairs. The DOD has taken the lead with the release of the Department of the Air Force’s 2020 Arctic Strategy to address national space security priorities within the region.¹⁶ However, this

¹³ Pendleton, 23.

¹⁴ James Clay Moltz, *Coalition Building in Space: Where Networks are Power* (Ft. Belvoir, VA: Defense Threat Reduction Agency, 2011), 7.

¹⁵ Moltz, 33.

¹⁶ Department of the Air Force, *The Department of the Air Force Arctic Strategy*.

thesis analyzes how an allied space policy for the Arctic region, with an associated implementation plan to address Arctic allied and partner civil, commercial, and defense space capabilities, would benefit United States strategic objectives within the Arctic. This thesis analyzes how the United States and its allies can leverage not only their significant defense relationships within the region, but also combine their respective civil, commercial, and multinational assets to mitigate Arctic strategic capability gaps and enhance space operations and associated capabilities in the region.

Fortunately, the United States maintains a considerable network of allies and partners within and around the Arctic region. Of the eight Arctic States consisting of Canada, the Kingdom of Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden, and the United States,¹⁷ four are United States North Atlantic Treaty Organization (NATO) allies including Canada, the Kingdom of Denmark, Iceland, and Norway; and Finland and Sweden are NATO Enhanced Opportunities Partners.¹⁸ The criticality of this extensive defense network is highlighted in the 2019 DOD Arctic Strategy, stating, “[t]he network of U.S. allies and partners with shared national interests... is the United States’ greatest strategic advantage in the Arctic region, and thus the cornerstone of DOD’s Arctic strategy.”¹⁹ However, current Arctic strategies and strategic initiatives to bridge existing capability gaps are exacerbating an already complex problem by seeking national solutions that are consistently underinvested in rather than leveraging Arctic allies and partners within the region. In line with the 2018 DOD National Defense Strategy (NDS), the United

¹⁷ Arctic states refer to those countries that are members of the Arctic Council: Canada, the Kingdom of Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States.

¹⁸ Enhanced Opportunities Partner is a NATO partner program designed to strengthen interoperability between NATO partners and allies; Australia, Finland, Georgia, Jordan, Sweden, and Ukraine are enhanced partners as of May 2021.

¹⁹ Office of the Under Secretary of Defense for Policy, *Report to Congress: Department of Defense Arctic Strategy* (Washington, DC: Department of Defense, 2019), 2, <https://media.defense.gov/2019/Jun/06/2002141657/-1/-1/1/2019-DOD-ARCTIC-STRATEGY.PDF>.

States' extensive network of allies and partners within the Arctic provides "a durable, asymmetric strategic advantage that no competitor or rival" within the region can match.²⁰

Years of underinvestment in the Arctic since the end of the Cold War leaves the United States catching up to potential adversaries that are prioritizing the region due to its future geostrategic value. As United States regional influence diminishes, U.S. economic and national security interests in the Arctic are being threatened. Current U.S. space policy recognizes that global commitments must be balanced against limited national resources. The 2017 DOD International Space Cooperation Strategy emphasizes that the current operational environment "necessitates prioritizing international space cooperation activities to maximize mutually beneficial national security return on investment."²¹ It goes on to say that growing threats to national security interests requires greater international engagement and cooperation to address space operations and associated capability gaps. Furthermore, the 2018 NDS emphasizes the value of alliances to the United States. It states, "our network of alliances and partnerships are the backbone of global security."²² The commander of USNORTHCOM in a March 2020 report to the Senate Armed Services Committee on Arctic policy, reemphasized this position, stating, "Our network of allies and partners is the cornerstone of the Department's approach to the Arctic region and represents a strategic advantage for the United States, which China and Russia do not possess."²³

But why are Arctic allies and partners so important? And if space cooperation is so important, why has it been so difficult to achieve significant results? This thesis investigates how a comprehensive cooperative strategy to build space collaborative

²⁰ Department of Defense, *Summary of the 2018 National Defense Strategy of the United States of America* (Washington, DC: Department of Defense), 8, <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>.

²¹ Department of Defense, *DOD International Space Cooperation Strategy* (Washington, DC: Department of Defense, 2017), 5, <https://www.hsdl.org/?view&did=805231>.

²² DOD, *Summary of the 2018 National Defense Strategy of the United States of America*, 2.

²³ *Statement for the Record before the Senate Armed Services Committee, Subcommittee on Readiness and Management Support, on U.S. Policy and Posture in Support of Arctic Readiness*, Senate, March 3, 2020, 2–4, https://www.armed-services.senate.gov/imo/media/doc/20-09_03-03-2020.pdf.

capacity is necessary to address Arctic strategic capability gaps and limitations. An important question that must be answered is not whether the United States should engage in space cooperation initiatives within the Arctic region, but rather, can the United States afford not to lead collaborative initiatives related to space considering its underfunded and disadvantaged position in the Arctic?

C. LITERATURE REVIEW

While there has been ample study of international cooperation and competition in space, there is relatively little research available on the challenges and opportunities related to regional space cooperation specific to the Arctic region. This is largely attributed to the relatively nascent or non-existent space programs of U.S. allies and partners within the region until recently. A key exception is the space cooperation between Canada and the United States with collaboration through both the National Aeronautics and Space Administration (NASA) and the defense sector. As the Arctic is a vital geostrategic region bounded by great powers, regional collective action in space has largely coincided with the escalation of American and Russian military presence within the region. Like the space domain, the Arctic strategic environment has been defined by great power competition. Today's Arctic and space domain are no different, with a reemerging Russian military presence and rising Chinese economic investment drawing U.S. attention back to the Arctic. Surveying the literature written on U.S. space cooperation within the Arctic region since the beginning of the Cold War, there are two identifiable points of inflection that are largely dependent on the geopolitical reality of the time: *Arctic nationalism* beginning in the Cold War and characterized by space dominance culminating with General Secretary of the USSR, Mikhail Gorbachev's "zone of peace" speech in 1987; and *Arctic cooperative security* characterized by space assurance and the current operating environment.²⁴

The period of *Arctic nationalism* throughout the Cold War witnessed the United States and the Soviet Union competing for space dominance and regional hegemony of the

²⁴ Gunhild Hoogensen Gjørsv and Kara K. Hodgson, "'Arctic Exceptionalism' or Comprehensive Security"? Understanding Security in the Arctic," *Arctic Yearbook 2019—Redefining Arctic Security* (November 11, 2019), 1, https://arcticyearbook.com/images/yearbook/2019/Scholarly-Papers/11_AY2019_Hoogensen_Hodgson.pdf.

Arctic. *Arctic nationalism* was characterized by U.S. geopolitical dominance of the Arctic region through “the sound and rational development of the Arctic” and promoted essential U.S. security interests through mutually beneficial international cooperation.²⁵ Le Mière and Mazo point out that, as “the shortest route between the Soviet Union and the continental United States for aircraft and ballistic missiles,”²⁶ the Arctic region was a geostrategic buffer zone where space operations were critical for strategic air defense, missile defense and early-warning, multi-domain awareness, and C3ISR. U.S. space cooperation initiatives were largely focused on interorganizational collaboration between NATO allies that enhanced strategic nuclear deterrence through terrestrial and space-based sensors and provided for the protection of essential U.S. security interests in the Arctic. Two significant space collaboration initiatives were the building of the Distant Early Warning (DEW) Line and the establishment of North American Aerospace Defense Command (NORAD). The DEW Line consisted of a string of early-warning radar stations across the entire far north of the North American continent to include locations in the United States via Alaska’s Aleutian Islands, as well as NATO allies Canada, the Kingdom of Denmark (via the Faroe Islands and Greenland), and Iceland.²⁷ Additionally, the historical bilateral cooperative agreement of the United States and Canada with the establishment of NORAD on 12 September 1957 provided aerospace warning, aerospace control, and maritime warning in the defense of North America.²⁸

The competitive race for space dominance in the Arctic witnessed what Everett Dolman in his book *Astropolitik* described as the astropolitical policy of astrostrategy, or “the identification of critical terrestrial and outer space locations, the control of which can provide military and political dominance of outer space, or at a minimum can insure against

²⁵ U.S. National Security Council, *National Security Decision Memorandum 144: United States Arctic Policy and Arctic Policy Group* (Washington, DC: National Security Council, 1971), 1, <https://fas.org/irp/offdocs/nsdm-nixon/nsdm-144.pdf>.

²⁶ Christian Le Mière and Jeffrey Mazo, *Arctic Opening: Insecurity and Opportunity* (New York: Routledge, 2013), 82.

²⁷ Le Mière and Mazo, 82.

²⁸ “About North American Aerospace Defense Command,” North American Aerospace Defense Command, accessed October 20, 2020, <https://www.norad.mil/About-NORAD/>.

the same dominance by a potential opponent state.”²⁹ Although his work has been controversial since it was published in 2002, Dolman argues that the United States should seize control of outer space and become a watch dog to maintain space dominance and by extension global control.³⁰ He characterized space as “the ultimate high ground” and theorized that the weaponization of space was inevitable as nations attempt to counter adversary advantages within the space domain.³¹ The Arctic and the polar region above it represent geostrategic and astrostrategic choke points. Due to the physics determining orbital mechanics, space objects in polar low-earth orbit (LEO) orbits must pass over the polar region.

Similarly, as the shortest distance between great powers, the Arctic is a strategic avenue of approach. Dolman goes on to say that “control of these few geographically determined locations would guarantee dominance over global military movement and world trade to the overseeing state.”³² According to Joint Publication 3-14: Space Operations, dominance equates to the ability of the United States to project national power at a “time, place, manner, and domain” of its choosing.³³ Consequently, Dolman advocated for the necessity of projecting national power and controlling strategically advantageous positions both terrestrially and in space to achieve strategic objectives. Like dominance of an area or key terrain both terrestrially and in space, control assures the use of the domain through deterrence and the application of national power to achieve strategic objectives.³⁴ Although controversial, his words have proven to be prophetic as polar great power competition sees the race for Arctic and space dominance continue today.

²⁹ Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (New York: Frank Cass Publishers, 2002), 15.

³⁰ Dolman, 157.

³¹ Dolman, 151.

³² Dolman, 34.

³³ Joint Chiefs of Staff, *Space Operations*, JP 3-14 (Washington, DC: Joint Chiefs of Staff, 2020), vii, https://fas.org/irp/doddir/dod/jp3_14.pdf.

³⁴ Joint Chiefs of Staff, *Space Operations*, JP 3-14, II-2.

However, critics would argue that Dolman's work lacked a "comprehensive theory of space power, as its argument only resonates in the United States and lacks the universalism that marks all great works of strategic theory."³⁵ Jonathan Havercroft and Raymond Duvall's article "Critical Astropolitics: The Geopolitics of Space Control and the Transformation of State Sovereignty" asserts that Dolman's theories emphasized too strongly a "preference for competition over collaboration in both the economic and military spheres" of influence.³⁶ Furthermore, Johnson-Freese and Smith argue that the pursuit of space dominance stems largely from fear and self-interest and that "prudence regarding military readiness with an equal amount of active, preventive diplomatic efforts" provides a stronger strategic deterrent.³⁷ Although the Arctic witnessed space policies and practices largely emphasizing geostrategic control through surveillance and power projection during the Cold War, there were multiple examples of space collaboration between both United States allies and partners as well as between the United States and the Soviet Union. The Arctic "maintained a 'negative peace' whereby the region was a buffer zone between the superpowers during the Cold War."³⁸

The Obama administration's 2010 National Space Policy (NSP) renewed U.S. initiatives to strengthen international collaboration in space. The policy emphasized the need to "expand international cooperation on mutually beneficial space activities to: broaden and extend the benefits of space; further the peaceful use of space; and enhance

³⁵ John Sheldon and Colin Gray, "Theory Ascendant? Spacepower and the Challenge of Strategic Theory," in *Toward a Theory of Spacepower*, eds. Charles Lutes and Peter Hays, (Washington, DC: National Defense University, 2011), 307, <https://ndupress.ndu.edu/Portals/68/Documents/Books/spacepower.pdf>.

³⁶ Jonathan Havercroft and Raymond Duvall, *Critical Astropolitics: The Geopolitics of Space Control and the Transformation of State Sovereignty* (New York: Routledge, 2009), 45, <https://www.law.upenn.edu/live/files/7892-havercroft-and-duvallcritical-astropoliticspdf>.

³⁷ Joan Johnson-Freese and Kenneth Smith, "U.S. Space Dominance: An Ethics Lens," Center for Ethics and the Rule of Law, University of Pennsylvania Law School, April 6–7, 2018, 28, <https://oxford.universitypressscholarship.com/view/10.1093/oso/9780197548684.001.0001/oso-9780197548684-chapter-6>.

³⁸ Gunhild Hoogensen Gjørsv and Kara K. Hodgson, "'Arctic Exceptionalism' or Comprehensive Security"? Understanding Security in the Arctic," 2.

collection and partnership in sharing of space-derived information.”³⁹ In contrast to the Bush administration’s 2006 NSP, the Obama administration sought “bilateral and multilateral transparency and confidence-building measures to develop equitable and verifiable international agreements to improve space security.”⁴⁰ It further stipulated that the civil, commercial, and defense interagency must identify areas for international cooperation to promote costs and risk-sharing agreements with participating nations that “augment U.S. capabilities by leveraging existing and planned space capabilities of allies and space partners.”⁴¹

The Obama administration sought to reorient national space policy objectives away from a nationalistic competitive approach to space, and instead “adopted an informal, consensus-building strategy” that “emphasized international outreach and the need to develop common norms to promote safe and responsible space operations.”⁴² Additionally, the NSP provided national security space guidance to the Secretary of Defense and the Director of National Intelligence to develop, maintain, and integrate space operations and associated capabilities to improve operational efficiencies across the various departments and agencies within the DOD and intelligence community (IC).⁴³ The Obama administration recognized the growing threats of a resurgent Russia and a rising China, and emphasized the need for collective action to promote security and stability utilizing United States allies and leveraging the emerging commercial space sector to achieve the “responsible and peaceful use of space.”⁴⁴ The subsequent 2011 National

³⁹ White House, *National Space Policy of the United States of America* (Washington, DC: White House, 2010), 4, https://obamawhitehouse.archives.gov/sites/default/files/national_space_policy_6-28-10.pdf.

⁴⁰ White House, 7.

⁴¹ White House, 7.

⁴² James Clay Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests, Third Edition* (Stanford, CA: Stanford University Press, 2019), 305; 313.

⁴³ White House, *National Space Policy of the United States of America* (2010), 13–14.

⁴⁴ Department of Defense and Director of National Intelligence, *National Security Space Strategy (Unclassified Summary)* (Washington, DC: Department of Defense, 2011), 5, https://www.dni.gov/files/documents/Newsroom/Reports%20and%20Pubs/2011_nationalsecurityspacestrategy.pdf.

Security Space Strategy (NSSS) laid the framework for the United States to “address the growing challenges of the congested, contested, and competitive space environment while continuing [United States] leadership in the space domain.”⁴⁵

Similarly, the 2018 National Defense Strategy argues that the United States is “emerging from a period of strategic atrophy, aware that our competitive military advantage has been eroding.”⁴⁶ The United States’ choice to act as a “reluctant Arctic power” and withdraw in the post-Cold War period, caused space capabilities within the region to atrophy and geopolitical influence amongst key allies to degrade. Furthermore, rapid change and increasing human activity demands greater capability with increased capacity during a time when the United States has neglected its Arctic commitments. Dolman would prophesize, “The lack of an enemy in space is most assuredly causing complacency in the United States, stunting expansion of its space capabilities, and further causing our allies to develop their own potentially conflicting military space capacities because they cannot be sure of U.S. commitments in the future.”⁴⁷ Steven Lambakis supports the need for allied space structures to address this capability gap stating, “The United States will need the political support of its allies and friends as well as their involvement in military space activities, to include economic contribution through collaboration in system development and participation in operations.”⁴⁸ He goes on to say that “There are ground elements, and surveillance activities that are critical to all military space missions, and there are undoubtedly several contributions U.S. allies can make in these areas.”⁴⁹

⁴⁵ DOD and DNI, *National Security Space Strategy (Unclassified Summary)*, 4.

⁴⁶ Department of Defense, *Summary of the National Defense Strategy of the United States of America* (Washington, DC: Department of Defense, 2018), 1, <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>.

⁴⁷ Dolman, *Astropolitik*, 157.

⁴⁸ Steven Lambakis, *On the Edge of Earth: The Future of American Space Power* (Lexington, KY: The University Press of Kentucky, 2001), 285.

⁴⁹ Lambakis, *On the Edge of Earth*, 285.

As previously mentioned, U.S. capability gaps have largely gone unresolved for several decades. A recent Center for Strategic and International Studies (CSIS) report attributes U.S. stagnation in Arctic development on a failure of U.S. policymakers to understand the strategic implications of emerging polar great power competition in the Arctic. The report argues that, “While the United States believes the Arctic will remain of limited strategic value and that its current minimalist posture is sufficient, its two near-peer competitors, Russia and China, have taken dramatically different and long-term views of the region and have expanded their military and economic footprints.”⁵⁰ It goes on to say that “Despite over a decade of studies and assessments, the [United States] continues to rely on outdated capabilities and thinly resourced budgets.” U.S. Arctic policy and implementation strategies are largely descriptive in nature and although they identify lines of effort and associated priorities, they continue to fail to alter resources or establish permanent organizational structure that will advance national geostrategic interests in the Arctic region.

However, the challenges to build space collaborative capacity in the Arctic are immense. Nascent and emerging space programs within the Nordic countries have constrained budgets, U.S. strategic priorities lie elsewhere in the South China Sea, and Canada’s primary Arctic-focus is on maritime security with modest investment elsewhere.⁵¹ Gunhild Gjörv in his work on understanding security in the Arctic argues that a comprehensive security approach must be taken within the Arctic that “neither rejects processes of cooperation, nor denies areas of tension that foster increased perceptions of insecurity. Instead, it provides an analytical tool that exposes the way in which security narratives in the region are complementary, or in competition, at a given time.”⁵² Additionally, Isaiah Honable in his research on space theories, concludes, “for a unified

⁵⁰ Heather A. Conley, “The Implications of U.S. Policy Stagnation Toward the Arctic Region,” Center for Strategic & International Studies, last modified May 3, 2019, <https://www.csis.org/analysis/implications-us-policy-stagnation-toward-arctic-region>.

⁵¹ Le Mière and Mazo, *Arctic Opening: Insecurity and Opportunity*, 99.

⁵² Gjörv and Hodgson, “‘Arctic Exceptionalism’ or Comprehensive Security’? Understanding Security in the Arctic,” 1.

space theory to be broadly applicable, it must encompass space capabilities as they relate to all the aspects of national power.”⁵³ The same can be said for a comprehensive space cooperative strategy within the Arctic inclusive of Arctic allies and partners within the region.

D. POTENTIAL EXPLANATIONS AND HYPOTHESES

Recognizing the need for change and seeking to transform space capabilities within the Arctic is a challenging task made even more difficult by finite budgets and competing global fiscal and operational commitments. Gjorv and Hodgson’s research points out that the post-Cold War era introduced the security concept of *Arctic exceptionalism*, which characterized the region as “detached from global political dynamics” and distinguished the Arctic as “an apolitical space of regional governance, functional cooperation, and peaceful co-existence.”⁵⁴ However, the past decade of Arctic national policies and DOD Arctic strategies reflects a renewed assessment of the evolving Arctic security and economic environments. In a 2017 brief to Congress, General Joseph Dunford, chairman of the Joint Chiefs of Staff, sounded the alarm by stating, “In just a few years, if we do not change the trajectory, we will lose our qualitative and quantitative competitive advantage.”⁵⁵ Subsequently, updated strategies reflect the evolving United States strategic interests in the Arctic in an era of polar great power competition.

The compelling need to transform strategic capabilities provides the catalyst to address capability gaps and develop innovative proposals which are strategically responsive, feasible, and achievable. As identified by NPS author and defense strategist, Dr. Scott Jasper, “Transformation, irrespective of the level it occurs at, can be carried out

⁵³ Isaiah Honable, “Space Theories Wanted,” The Strategy Bridge, last modified November 13, 2018, <https://thestrategybridge.org/the-bridge/2018/11/9/space-theories-wanted>.

⁵⁴ Gjorv and Hodgson, “‘Arctic Exceptionalism’ or Comprehensive Security’? Understanding Security in the Arctic,” 2.

⁵⁵ Jim Garamone, “Dunford Urges Congress to Protect U.S. Competitive Advantage,” DOD News, U.S. Dept of Defense, last modified June 12, 2017, <https://www.defense.gov/Explore/News/Article/Article/1211668/dunford-urges-congress-to-protect-us-competitive-advantage/>.

only if it is understood and accepted in terms of necessity.”⁵⁶ Emerging national space collaborative concepts as well as the recently published 2020 NSP recognize the necessity of space cooperation and have called for the preservation and expansion of U.S. leadership in space with likeminded international partners.⁵⁷ A review of literature related to policies and capability needs within the Arctic and space reveals three potential explanations for how the United States can build space collaborative capacity and benefit from space cooperation in the Arctic.

First, it can be credibly hypothesized that the Arctic will continue to be a region of cooperation among U.S. allies and partners, with the space domain loosely benefiting from established cooperative norms within the region. It can be argued that this would see a continuation of limited bilateral cooperation amongst the United States and certain allies and partners within the Arctic. Although this could be characterized as a continuation of the status quo, the Trump administration’s “America First” approach to international relations demonstrates that continued U.S. engagement with allies is no foregone conclusion. Michael Byers concludes in his work on international cooperation in the Arctic and space that “the more states need to cooperate in a particular region or issue-area, and the more they become accustomed to doing so, the more resilient that cooperation will become.”⁵⁸ He terms this phenomenon: “complex and resilient interdependence.”⁵⁹ Byers argues that the remote and extreme operating environments of both the Arctic and space as well as the required interaction of states to overcome region or domain specific challenges necessitates cooperation. He specifically, “compares Russian-Western cooperation in the Arctic and space with a focus on why cooperation continued after the 2014 annexation of

⁵⁶ Scott Jasper, “The Capabilities-Based Approach,” in *Transforming Defense Capabilities: New Approaches for International Security*, ed. Scott Jasper (Boulder: Lynne Rienner Publishers, 2009), 7.

⁵⁷ White House, *National Space Policy of the United States of America* (Washington, DC: White House, 2020), 6, <https://trumpwhitehouse.archives.gov/wp-content/uploads/2020/12/National-Space-Policy.pdf>.

⁵⁸ Michael Byers, “Cold, Dark, and Dangerous: International Cooperation in the Arctic and Space,” *Polar Record* 55, no. 1 (2019): 32–47. 1, doi:10.1017/S0032247419000160.

⁵⁹ Byers, 1.

Crimea.”⁶⁰ Although Byers’ comparative approach focused on cooperative factors between Russia and principally the United States in space and the Arctic during that time, his conclusions on why the Arctic and space create opportunities for cooperation contribute to this thesis’ main question of how to build space collaborative capacity amongst U.S. allies and partners within the region.

A review of U.S. space initiatives in the Arctic points to not only an internal balancing of resources to mitigate capability gaps within the region, but external balancing with Arctic allies and partners. As an example, the United States and Canada are collaborating on the Enhanced Satellite Communications Project - Polar, and the United States is leveraging Norway to modernize the Enhanced Polar System Recapitalization project.⁶¹ Both of these programs are bilateral collaborative efforts to mitigate Arctic communications gaps that also address U.S. strategic capability shortfalls within the region. Although these are only two projects of many currently being worked on by the United States and its Arctic allies and partners, current initiatives would appear to validate the initial hypothesis that the Arctic presents an opportunity as a zone of cooperation in space. Although this hypothesis remains credible, the growing tensions in the Arctic will likely require a more robust and focused response from the United States to encourage greater regional space collaborative efforts to address Arctic specific concerns.

Second, it can be argued that longstanding Arctic intergovernmental forums provide the structure necessary to stimulate regional space cooperation and support collaborative efforts through resource investment in shared regional objectives through multilateral cooperation. As previously discussed, collective action is principally driven by shared grievances and the felt need to collaborate to achieve national interests. The need for collaboration is important, but equally important is the organizational structure to create

⁶⁰ Byers, 1.

⁶¹ Nathan Strout, “How 2 Space Norway Satellites Will Help the Air Force in the Arctic,” last updated July 5, 2019, <https://www.c4isrnet.com/battlefield-tech/2019/07/05/how-2-space-norway-satellites-will-help-the-air-force-in-the-arctic/>; Marc Boucher, “DND Releases Enhanced Satellite Communications Project – Polar Follow-on Summary of Feedback and Outcomes,” SpaceQ, last updated August 6, 2019, <https://spaceq.ca/dnd-releases-enhanced-satellite-communications-project-polar-follow-on-summary-of-feedback-and-outcomes/>.

lasting results. Fortunately, the United States enjoys significant political, economic, and defense relationships within the region in well-established organizational structures to facilitate cooperative agreements. The Arctic region has a significant number of established intergovernmental forums to include NATO, the European Union, the European Space Agency, the Nordic Council, and NORAD among others. Moltz, in his article “Coalition Building in Space: Where Networks are Power,” advocates for an “allied space network as a possible means of both reducing risks and enhancing space power.”⁶² He goes on to say that “trans-national networks and alliances offer considerable untapped potential, with possibly significant benefits particularly for the United States, which – unlike China and Russia – already has established military alliances with a number of countries possessing or now developing advanced space capabilities.”⁶³ A comprehensive transnational Arctic network consisting of allies and partners would leverage existing intergovernmental structure within the Arctic and potentially provide a more robust response to mitigating U.S. strategic capability gaps within the region.

Third, it can be hypothesized that a more robust Arctic cooperative space strategy will fail to materialize due to a combination of regional specific challenges, such as nationalism, lack of dedicated resources, conflicting political goals, and a lack of sustained political leadership to implement long term results. Although the United States, and the DOD specifically, has acknowledged the need to build collaborative space capacity in the Arctic, there are significant challenges to overcome in the implementation of a collaborative comprehensive allied space concept. The recent Trump administration called for expanding international cooperation in space and the Arctic through multilateral forums.⁶⁴ However, the administration’s insistence on challenging multilateral partners and demands for increased alliance spending reflected an American nationalistic approach that damaged U.S. alliances. In his study on international cooperation in space, Cody

⁶² Moltz, “Coalition Building in Space: Where Networks are Power,” 1.

⁶³ Moltz, 1.

⁶⁴ White House, *National Space Policy of the United States of America* (2020), 5; White House, *National Security Strategy of the United States of America* (Washington, DC: White House, 2017), 40, <https://trumpwhitehouse.archives.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf>.

Knipfer highlights key challenges in space collective action noting that “countries are inherently self-interested; their activity in and use of space serves a distinct goal—political, economic, scientific, or national security—that brings them benefit, international competitive advantage, and justifies the costs and complexities involved in a space program.”⁶⁵ Problems in space collective action largely stems from nationalism, lack of resources due to cost; programmatic stability and political consistency; a reluctance to transfer sensitive or proprietary information; a mistrust based on competition over interests; and an unwillingness of allies and partners to address space security concerns. These factors and others are addressed in greater detail in chapter three of this thesis.

E. RESEARCH DESIGN

This thesis investigates current U.S. strategic capability gaps and evaluates the necessity of space operations and associated capabilities to mitigate regional resource shortfalls and meet U.S. Arctic-related strategic objectives. Research will primarily consist of open source, qualitative analysis of allied and partner national policies, military strategic documents, commercial projects, and civil space cooperation initiatives; however, quantitative open-source figures to include budgets, launch statistics, and ongoing space unclassified programs are incorporated throughout the analysis. Additionally, a review of literature related to the geostrategic importance of the Arctic and a brief history of U.S. national space and Arctic policies provides the strategic context for the desirability of space operations to address Arctic technical and geopolitical challenges. Reviewed materials referenced throughout the analysis primarily consist of academic journals, research papers, and books from academic publishers as well as web-based sources to include reliable news sources, government sites, government and academic policy centers, and official government publications.

This thesis analyzes space cooperation opportunities and challenges with the goal of offering a comprehensive overview of the nascent and established allied and partner Arctic space programs, their current national trajectories, and their political, economic, and

⁶⁵ Cody Knipfer, “International Cooperation and Competition in Space (Part 1),” *The Space Review*, last modified November 20, 2017, <https://thespacereview.com/article/3376/1>.

defense motivations in building space collaborative capacity within the Arctic.⁶⁶ To qualitatively evaluate the potential to build collaborative capacity within the Arctic, this thesis leverages an interorganizational collaborative capacity (ICC) model to evaluate ICC through five design factors of purpose and strategy, lateral mechanisms, people, structure, and incentive and reward systems.⁶⁷ The ICC model provides a framework to analyze interorganizational collaboration behavior and determines factors that influence countries to “enter, develop, and sustain interorganizational systems in pursuit of collective outcomes.”⁶⁸ Furthermore, within this thesis, rationales for partnering in allied space activities are explored and common barriers to allied and partner space collaborative actions are identified.

This thesis utilizes comparative case studies to determine how allies and partners in the region could help ensure adequate C3ISR and communications coverage to maximize domain awareness and build collaborative space capacity within the Arctic. Additionally, this thesis investigates the current state of allied and partner space capabilities, explores motivations and key trends of the respective space programs, and provides a qualitative assessment of each country’s space capabilities that could contribute to building space collaborative capacity within the region. Given their comparatively advanced role in terms of technology, longevity, and economic investment, this thesis mainly references the space programs of Canada, Denmark, Norway, and Sweden, but it will also discuss the nascent space activities of Finland and Iceland and their potential contributions to Arctic space cooperation.

The aim of this thesis is not to provide a definitive operational history of each of these countries in space, but rather to explore the motivations and key trends of their respective space programs and, specifically, to identify areas in which the United States

⁶⁶ James Clay Moltz, *Asia’s Space Race: National Motivations, Regional Rivalries, and International Risks* (New York: Columbia University Press, 2012), 7.

⁶⁷ Susan P. Hocevar, “Building Collaborative Capacity for Maritime Security,” in *Conflict and Cooperation in the Global Commons*, ed. Scott Jasper (Washington, DC: Georgetown University Press, 2012), 124.

⁶⁸ Hocevar, 124.

could build space collaborative capacity through space and security related benefits. The policy recommendations at the conclusion are intended to inform the State Department, the DOD, Homeland Security, and the Office of the Director of National Intelligence to form the basis of a new, competitive, and realistic U.S. comprehensive space strategy for the Arctic. The gap this thesis seeks to fill is to provide original analysis covering the comparative motivations for space activity among Arctic countries within the regional context and how the United States could benefit from a space cooperation strategy within the region to achieve strategic objectives.⁶⁹

F. THESIS OVERVIEW

This thesis is organized into five chapters that seek to analyze how the United States could build allied and partner space collaborative capacity within the Arctic region. The thesis guides the reader through the possible need for space collaborative capacity within the Arctic, the challenges of space collaborative action within the region, and opportunities for cooperation with allies and partners through bilateral, multilateral, and intergovernmental cooperative space initiatives. The first chapter introduced the importance of space operations and associated capabilities to mitigate U.S. strategic capability gaps within the Arctic, presented the major research question, provided its significance, reviewed relevant literature related to U.S. space cooperation as it pertains to the Arctic region, and suggested three different competing hypotheses that seek to answer the research question.

The second through fourth chapters provide the reader an understanding of the opportunities and challenges of cooperative space initiatives within the Arctic region. The second chapter highlights the geostrategic importance of the Arctic to U.S. national security interests and emphasizes the need for urgency to address current U.S. strategic capability gaps within the region. The third chapter explores the possible rationales and presents challenges for building space collective action within the Arctic region. The fourth chapter provides a comparative case study of existing allied and partner space capabilities

⁶⁹ Moltz, *Asia's Space Race*, 9.

within the Arctic region. Economic, military, and political motivations for space activity is assessed, and brief histories of military and scientific activity in the space domain is addressed. This thesis examines the space collaborative capacity of two spacefaring U.S. allies within the Arctic: Denmark and Norway. These case studies assess the potential for bilateral and regional space collective action within the Arctic and the possible benefits to the United States. Each is analyzed through three parts, identified by a brief history of space activity, motivations and key trends of Arctic space programs, and areas of cooperation for building space collaborative capacity in the Arctic within the future. Additionally, NATO and the Arctic is addressed as an avenue to building intergovernmental space collaboration.

The final chapter summarizes the research and analyzes the geopolitical reality of current Arctic space programs and the opportunities and challenges of building U.S. allied and partner space collaborative capacity within the Arctic. Additionally, the proposed hypotheses for answering the major research question are revisited and evaluated based on gathered quantitative and qualitative data. Furthermore, areas for enhanced cooperation are identified based on shared political objectives, historic areas of collaboration, and political will as expressed by current space strategies and policies of allies and partners within the region. This thesis investigates how the United States might benefit from a cooperative space strategy for the Arctic and whether the United States would benefit from building collaborative space capacity within the Arctic to mitigate its strategic capability gaps. The thesis suggests that the United States should build space collaborative capacity within the Arctic through an implementation plan that considers the regional challenges of space cooperation in the Arctic, leverages the strength of cooperative relationships within the region, and advocates for a transnational network of allies and partners through the existing network of intergovernmental forums. The rationale developed in this thesis to research, analyze, and evaluate allied and partner space collaborative capacity within the Arctic could be applied to other regions to help expand and enhance partnerships in the space domain.

II. BUILDING SPACE COLLABORATIVE CAPACITY

This chapter on the geostrategic importance of the Arctic to U.S. national security interests has four parts. The chapter provides an overview of U.S. Arctic policy and national security interests as they relate to the space domain and provides the strategic context to the rapidly changing geostrategic conditions in the region. Additionally, the chapter investigates the space collaborative capacity of the United States to develop and sustain bilateral, multilateral, and intergovernmental space cooperative security through a comprehensive cooperative capabilities-based assessment of the current Arctic operational environment.

The first part describes the Arctic as a geostrategic environment and discusses the dynamic and challenging operational environment that the United States must overcome to assert its influence within the region. The second part introduces the complexity of the increasing political and geostrategic value of the Arctic as an arena for polar great power competition and homeland defense. The third part provides a brief history of U.S. Arctic policies that emphasizes the strategic context for the desirability of space operations to address Arctic technical and geopolitical challenges. The fourth part discusses space collaborative capacity within the Arctic through a review of identified national interests, established policies, and mechanisms for space-based cooperative behavior. A review of recent U.S. space and Arctic policies provides a strategic framework in which to analyze space collaborative capacity as it relates to current U.S. strategy and political rhetoric. Finally, the last part analyzes the preceding five parts to assess the need for the United States to address strategic capability gaps through the geostrategic context of polar great power competition.

A. THE ARCTIC AS A GEOSTRATEGIC ENVIRONMENT

The United States has largely recognized the geostrategic importance of the Arctic since becoming an Arctic State with the 1867 acquisition of Alaska. Although the purchase of Alaska was initially ridiculed as a \$7.2 million “polar bear garden,” the U.S. acquisition from Russia has come to be seen as a geopolitical achievement providing the United States

a “forward position in the Pacific, a vital source of domestic oil and gas, and a point of access to the Arctic Ocean.”⁷⁰ As early as 1935 in a speech to Congress, Brigadier General Billy Mitchell, whom many consider to be the father of the U.S. Air Force, insisted that, “whoever holds Alaska will hold the world. I think it is the most important strategic place in the world.”⁷¹ This perspective continues today as codified in the U.S. Department of the Air Force’s 2020 Arctic Strategy when it emphasizes that, “The Arctic is a region of immense geostrategic significance and a key location for global power projection.”⁷² These assertions reinforce Dolman’s claim that the Arctic and polar space domain above it represent not only a geostrategic arena for competition, but an astrostrategic choke point for future exploitation, expansion, and influence.⁷³

The Arctic is primarily a maritime domain with large swaths of its landmass inhospitable to large population centers.⁷⁴ Consequently, U.S. efforts within the Arctic region are largely concentrated on enabling U.S. interests in the maritime domain or the air and space above it. As the smallest of the world’s great oceans, the Arctic Ocean is constrained by three strategic maritime corridors that have significant U.S. allied and partner presence, with Japan, South Korea, and Canada near the Bering Strait; Canada and Denmark via Greenland near the Davis Strait; and the Greenland, Iceland, United Kingdom (UK) – Norway (GIUK-N) Gap consisting entirely of U.S. NATO allies. Although Russia is the largest Arctic state by both population and size of its coastline, it is constrained by U.S. allies and partners along its Arctic maritime corridor. As identified in the U.S. Navy’s 2019 Strategic Outlook for the Arctic, “The [Bering] Strait has strategic significance since it enables Russia to connect its Asian and European naval forces. As the Pacific gateway

⁷⁰ Charles Emmerson, *The Future History of the Arctic* (New York: PublicAffairs, 2010), 62–63.

⁷¹ Lisa Murkowski, “Defense Issues,” U.S. Senate, U.S. Senator for Alaska, accessed March 12, 2021, <https://www.murkowski.senate.gov/issues/issues-and-priorities/defense?latest=52>.

⁷² Department of the Air Force, *The Department of the Air Force Arctic Strategy*, 4.

⁷³ Dolman, *Astropolitik*, 34.

⁷⁴ White House, *National Security Presidential Directive/NSPD – 66 and Homeland Security Presidential Directive/HSPD – 25* (Washington, DC: White House, 2009), 3, <https://fas.org/irp/offdocs/nspd/nspd-66.htm>.

for the Northern Sea Route and the Trans-Polar Route, the Bering Strait may become more important for seaborne trade between Europe and Asia.” Likewise, the GIUK-N Gap provides “a strategic corridor for naval operations in the high north...[and] serves as the Atlantic terminus for the Trans-Polar Route, which may become a viable economic option to ship goods from the Pacific to the Atlantic markets.”⁷⁵ Space operations and associated capabilities provide the means to enable and support maritime operations through space-based C3ISR and enhanced multi-domain awareness to include weather, communications, and ice coverage reports. Maintaining the security and international freedom of the seas within these strategic corridors is crucial for the United States to maintain peace and stability within the region and pressure potential adversaries to comply with the rules-based international order.

But the Arctic is undergoing dramatic change. The region is heating up as surface air temperatures rise twice as fast as the rest of the Earth. Additionally, reducing sea ice coverage is opening more efficient sea lines of communication with increased commercial, military, and tourism-related shipping across the region. Current estimates project that major sea lanes will be accessible twelve months of the year by 2040 and that the North Pole will be ice free by 2050.⁷⁶ These major sea lines of communication could reduce shipping times between Europe and Asia by as much as two to three weeks or greater depending on the transpolar route.⁷⁷ This changing physical environment is presenting economic opportunities while also highlighting U.S. strategic capability gaps as competition grows for Arctic economic and geopolitical influence.

Furthermore, estimated vast untapped natural resources have the potential to transform the Arctic into an area of increased human activity with significant geopolitical

⁷⁵ Department of the Navy, *The United States Navy Strategic Outlook for the Arctic* (Washington, DC: Department of the Navy, 2019), 8–9, https://media.defense.gov/2020/May/18/2002302034/-1/-1/1/NAVY_STRATEGIC_OUTLOOK_ARCTIC_JAN2019.PDF.

⁷⁶ James Stavridis, *Sea Power: The History and Geopolitics of the World's Oceans* (New York, Penguin, 2017), 240.

⁷⁷ Mia Bennet, “The Arctic Shipping Route No One’s Talking About,” *The Maritime Executive*, last modified May 8, 2019, <https://www.maritime-executive.com/editorials/the-arctic-shipping-route-no-one-s-talking-about>.

and security implications. The Arctic is a region with significant natural resources. A 2008 U.S. Geological Survey (USGS) estimated that “90 billion barrels of oil, 1,669 trillion cubic feet of natural gas, and 44 billion barrels of natural gas liquids” may remain to be discovered in the Arctic.⁷⁸ A 2012 U.S. Energy Information Administration report estimated that these figures would account for 13% of the world’s undiscovered conventional oil resources and 30% of the world’s undiscovered conventional natural gas reserves.⁷⁹ Moreover, the Prudhoe Bay Oil Field on Alaska’s North Slope possesses North America’s largest oil field, containing approximately 25 billion barrels of oil. Furthermore, it is estimated that close to 50% of U.S. fish stocks come from the 200 nautical mile exclusive economic zone (EEZ) off the coast of Alaska with an average wholesale value of nearly 4.5 billion dollars a year.⁸⁰ Consequently, the United States has substantial geopolitical, national security, economic, environmental, and energy strategic objectives amongst other interests in the region.

However, as previously mentioned, despite the significant geostrategic and economic value the region presents, U.S. policymakers have consistently underinvested in infrastructure, capabilities, and diplomatic initiatives to address the strategic capability gaps within the region. Fortunately, the Arctic is becoming accessible at a time when U.S. allies and partner’s civil, military, and commercial space industries have developed to a point where cooperative space-based solutions could be implemented. As highlighted in Karen Jones’ Aerospace article on “Closing the Arctic Infrastructure Gap,” space-based solutions “can support Arctic stakeholders needs for faster and ubiquitous communications, timely domain awareness, and an improved means to accurately navigate

⁷⁸ Kenneth J. Bird et al., “Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle,” U.S. Geological Survey Fact Sheet 2008–3049, 2008, <https://pubs.usgs.gov/fs/2008/3049/>.

⁷⁹ “Arctic Oil and Natural Gas Resources,” U.S. Energy Information Administration, 2012, <https://www.eia.gov/todayinenergy/detail.php?id=4650>.

⁸⁰ “Overview: Alaska,” NOAA Fisheries, last modified September 17, 2020, <https://www.fisheries.noaa.gov/region/alaska>.

and observe the region's rapidly changing conditions.”⁸¹ She goes on to say, “For remote Arctic regions, space systems provide critical infrastructure, which supports long-term national security, civil, environmental, and economic goals.”⁸² These space-based solutions provide the medium to address U.S. strategic capability gaps within the region, but the United States must weigh investment in the Arctic against competing global requirements in an era of great power competition.

B. POLAR GREAT POWER COMPETITION

The renewal of polar great power competition with the changing Arctic geopolitical and security environment is once again concentrating U.S. national security interests on a region traditionally viewed as an area of cooperation and low-tension. Professor Anne-Marie Brady, a Chinese politics, polar politics, and foreign policy expert from the University of Canterbury in New Zealand, characterized polar great powers, in her book *China as a Polar Great Power*, as “states that exhibit ‘global structural power,’ or the ability to shape governance frameworks in the economic, military, and political-diplomatic sectors.”⁸³ She goes on to state that, “to be considered a polar great power, a state must have high levels of polar scientific capacity and scientific research funding; a significant level of presence in the [Arctic]; and significant economic, military, political, and diplomatic capacity there; as well as a high level of international engagement in polar governance.”⁸⁴ The emerging political and geostrategic threat to U.S. interests in the Arctic by an expanding and modernized Russian military presence and rising Chinese economic and scientific influence is seeing the Arctic region become a geostrategic flash point for future polar great power competition, where Russia, China, and the United States vie for

⁸¹ Karen L. Jones, Samira Patel, and Martin N. Ross, “Closing the Arctic Infrastructure Gap: Existing and Emerging Space-Based Solutions,” *The Aerospace Corporation: Center for Space Policy and Strategy*, last modified October 21, 2019, 2, https://aerospace.org/sites/default/files/2019-10/Jones_ClosingArcticGap_10172019.pdf.

⁸² Jones, Patel, and Ross, “Closing the Arctic Infrastructure Gap: Existing and Emerging Space-Based Solutions.”

⁸³ Anne-Marie Brady, *China as a Polar Great Power* (New York: Cambridge University Press, 2017), 6.

⁸⁴ Brady, 6.

political and geostrategic influence in a region that has the potential to alter the rules-based international order.

A revisionist Russia with a resurgent Arctic presence presents a dynamic security challenge across multiple Geographic Combatant Commands (GCC) that is complex, all-domain, and multi-functional.⁸⁵ The 2019 DOD Arctic Strategy notes that, “Russia views itself as a polar great power and is the largest Arctic nation by landmass, population, and military presence above the Arctic Circle.”⁸⁶ The Russian Arctic coastline accounts for approximately 53 percent of the Arctic Ocean coastline, and Russia’s Arctic population of approximately two million people accounts for about half of the population living in the Arctic worldwide. Additionally, among the five Arctic littoral states of Canada, Denmark, Norway, Russia, and the United States, Russia possesses more than half of all the Arctic’s estimated oil and gas resources.⁸⁷

Recent Russian military reinvestment in the region has witnessed Russian heavy bombers conducting regular air patrols along the coastlines of countries within the region, and U.S. fighter aircraft routinely intercepting Russian military aircraft inside U.S. and Canadian Air Defense Identification Zones. Advanced air and sea-launched long-range precision-strike cruise missiles are being deployed within the region allowing greater standoff ranges well outside of U.S. radar coverage. Additionally, Russia has deployed the Severodvinsk-class guided missile submarine within the region, armed with low radar cross section land-attack cruise missiles.⁸⁸ These military capabilities are reinforced by Russia “refurbishing Cold War-era bases, setting up new units, opening ports and runways, and

⁸⁵ *Statement of General Curtis M. Scaparrotti, United States Army, Commander, United States European Command*: Testimony before the United States House of Representatives, Committee on Armed Services, March 13, 2019, 2, <https://www.eucom.mil/document/40288/2019-hasc-posture-statement>.

⁸⁶ Department of Defense, *2019 DOD Arctic Strategy*, 4.

⁸⁷ “Russia,” The Arctic Institute: Center for Circumpolar Security Studies, last modified June 19, 2020, <https://www.thearcticinstitute.org/russias-arctic-strategy-energy-extraction-part-three/>.

⁸⁸ *Statement of General Terrence J. O’Shaughnessy, United States Air Force, Commander, United States Northern Command and North American Aerospace Defense Command*: Testimony before the Senate Armed Services Committee, February 26, 2019, 4; 13, https://www.armed-services.senate.gov/imo/media/doc/OShaughnessy_02-26-19.pdf.

deploying radar and air-defense systems. In all, Russia has built 475 military facilities in the Arctic over the past six years [since 2019].”⁸⁹ Additionally, Russia is aggressively challenging Arctic maritime security through the enforcement of aggressive economic coercion along the NSR counter to international laws. These advances in its Arctic military defense significantly increase Russia’s ability to defend and control a large stretch of the NSR and have the potential for Russia to claim an expanded EEZ that will disrupt the regional balance of power and international economic system.⁹⁰

A rising China in the region is both an opportunity and challenge for the United States and its partners within the Arctic. In a January 2018 white paper titled “China’s Arctic Policy,” China declared itself a “near-Arctic state” and presented its “Polar Silk Road” economic plan to facilitate economic and social development of the Arctic. The plan emphasized China’s strategic interests within the Arctic and proposed a comprehensive strategy “to understand, protect, develop, and participate in the governance of the Arctic.”⁹¹ Although China is not an Arctic state, China was granted Arctic “observer status” within the Arctic Council in 2013.⁹² As an observer state, China agreed to recognize the eight Arctic states’ sovereignty, sovereign rights, and jurisdiction in the Arctic.

However, China has also identified the Arctic as an area of “undetermined sovereignty” in which it can assert its political and economic power to influence the regional governance structure. Chinese economic, military, political, and diplomatic influence within the Arctic region provides China strategic access to transpolar shipping

⁸⁹ Christopher Woody, “Russia is Finding New Islands in the Arctic, While the U.S. is Still Trying to Figure Out How to Get Up There,” *Business Insider*, last modified October 29, 2019, <https://www.businessinsider.com/russia-finds-new-arctic-islands-amid-great-power-competition-2019-10>.

⁹⁰ Eric Roston and Blacki Migliozi, “How a Melting Arctic Changes Everything, Part II: The Political Arctic,” Bloomberg, last modified May 16, 2017, <https://www.bloomberg.com/graphics/2017-arctic/the-political-arctic/>.

⁹¹ Xi Jinping, *China’s Arctic Policy*, The State Council Information Office of the People’s Republic of China, January 26, 2018, http://english.www.gov.cn/archive/white_paper/2018/01/26/content_281476026660336.htm.

⁹² According to the Arctic Council website, “observer status in the Arctic Council is open to non-Arctic States; inter-governmental and inter-parliamentary organizations, global and regional; and non-governmental organizations that the Council determines contribute to its work.” “Observers,” Arctic Council, accessed April 24, 2021, <https://arctic-council.org/en/about/observers/>.

routes between Asia and Europe that reduce China's dependence on southern sea routes that transit regions of U.S. influence and maritime control. China's geostrategic priorities within the Arctic are focused on security, economic resources, and strategic science.⁹³ In regard to space above the Arctic, Chinese space-related Arctic research focuses on research and development in the earth's magnetic field, the aurora, all domain awareness, strategic early warning, and space situational awareness (SSA) capabilities to extend China's operational reach.⁹⁴ Space analysts have noted that China may seek to improve its SSA capabilities to better identify on-orbit targets and provide accurate engagement criteria to support space defense and counter-orbiting systems.⁹⁵ China's President Xi Jinping clarified Chinese interest in the Arctic contending that, "Polar affairs have a unique role in our marine development strategy, and the process of becoming a polar power is an important component of China's process to become maritime great power."⁹⁶

Chinese polar interests are further illustrated in China's vertical world map that places China at the center of the world with the polar regions dominating to the north and south. The Chinese world view sees itself visually dominating the Asia-Pacific, while sidelining the U.S., and dwarfing the importance of Europe.⁹⁷ Additionally, in 2015, "the Chinese government announced that the polar regions, the deep seabed, and outer space are China's 'new strategic frontiers' (*zhanlüe xin jiangu*), strategically important areas from which China will draw the resources needed to become a global power."⁹⁸ This increased Chinese interest in the Arctic has witnessed China investing more money in

⁹³ Brady, *China as a Polar Great Power*, 7.

⁹⁴ Brady, 10.

⁹⁵ Bhavya Lal, Asha Balakrishnan, Becaja M. Caldwell, Reina S. Buenconsejo, and Sara A. Carioscia, "Global Trends in Space Situational Awareness (SSA) and Space Traffic Management (STM)" for the Institute of Defense Analysis, Science & Technology Policy Institute (Washington, DC: IDA Science & Technology Policy Institute, 2018), 22, <https://www.ida.org/-/media/feature/publications/g/gl/global-trends-in-space-situational-awareness-ssa-and-space-traffic-management-stm/d-9074.ashx>.

⁹⁶ Brady, *China as a Polar Great Power*, 3.

⁹⁷ Brady, 5.

⁹⁸ Brady, 7.

capacity than any other nation within the Arctic region,⁹⁹ with significant economic investments in Canada, Denmark via Greenland, Iceland, and Norway, and significant investments in Russia's Arctic oil and gas industry, ports, and infrastructure such as hotels.

As the global balance of power shifts from the unipolarity of U.S. dominance to a multipolar world with great power competition amongst Russia, China, and the United States, American Arctic influence is viewed to be declining as China is increasingly challenging U.S. hegemony across the globe.¹⁰⁰ A recent poll by the European Council on Foreign Relations estimated that approximately 52 percent of Swedish respondents and 48 percent of Danish respondents thought in ten years' time, China would be a stronger power than the United States compared to 29 and 34 percent respectively who thought the United States would maintain its advantage. Moreover, key European allies Great Britain, Germany, and France had even higher percentages of their populations that believed China would overtake the United States with 58, 56, and 62 percent compared to 19, 24, and 18 percent respectively that believed the United States would maintain its advantage.¹⁰¹ This eroding perception of U.S. prestige amongst key European allies and partners must be addressed by the U.S. if it seeks to maintain its regional dominance in Arctic affairs.

C. BACKGROUND OF U.S. ARCTIC POLICY

The U.S. government has articulated national Arctic policies since the 1970s with the Arctic acting as a geostrategic buffer zone during the Cold War between the Soviet Union and the United States. The Arctic played an important role during the Cold War in the defense of North America as a theatre for strategic air defense, early warning and missile defense, and a strategic maritime corridor for undersea submarine power

⁹⁹ Brady, 15.

¹⁰⁰ Saxena Abhishek, "The Return of Great Power Competition to the Arctic," The Arctic Institute: Center for Circumpolar Security Studies, last modified October 22, 2020, <https://www.thearcticinstitute.org/return-great-power-competition-arctic/>.

¹⁰¹ Ivan Krastev and Mark Leonard, "The Crisis of American Power: How Europeans See Biden's America," European Council on Foreign Relations, [ecfr.eu](https://ecfr.eu/publication/the-crisis-of-american-power-how-europeans-see-bidens-america/), last modified January 19, 2021, <https://ecfr.eu/publication/the-crisis-of-american-power-how-europeans-see-bidens-america/>.

projection.¹⁰² Since the Nixon administration's National Security Decision Memorandum 144 (NSDM-144) in 1971, the United States has supported "the sound and rational development of the Arctic." Guiding principles shaping U.S. Arctic policy identified environmental protection and scientific exploration, the promotion of international cooperation within the region, and the preservation of national security and economic interests in the Arctic as the overarching policy framework to achieve U.S. geostrategic interests.¹⁰³

The Arctic Research and Policy Act (ARPA) of 1984 under the Reagan administration further codified U.S. national interests within the region to "provide for a comprehensive national policy dealing with national research needs and objectives in the Arctic," and identified the Arctic as a strategic source of energy and renewable resources. Additionally, the Reagan administration emphasized the geostrategic significance of the region by labeling the Arctic as critical to national defense and one of the Nation's greatest commercial assets.¹⁰⁴ This agreement would also formally define U.S. recognized geographic boundaries of the Arctic region.

The post-Cold War era of *Arctic exceptionalism* brought geopolitical stability and constructive collaboration amongst the Arctic nations with the signing of the 1991 Arctic Environmental Protection Strategy (AEPS), which established an Arctic Monitoring and Assessment Program to monitor levels of pollutants and protect the marine environment in the Arctic.¹⁰⁵ Although the AEPS wasn't a binding treaty, it was seen as a monumental collaborative agreement amongst the Arctic nations, and was the precursor to the 1996 Ottawa Declaration, which established the Arctic Council as "the preeminent

¹⁰² Le Mière and Mazo, *Arctic Opening: Insecurity and Opportunity*, 82.

¹⁰³ U.S. National Security Council, *National Security Decision Memorandum 144: United States Arctic Policy and Arctic Policy Group*, 1.

¹⁰⁴ U.S. National Science Foundation, "Public Law 98-373. Arctic Research and Policy Act of 1984 (amended 1990)," 31 July 1984, https://www.nsf.gov/geo/opp/arctic/iarpc/arc_res_pol_act.jsp.

¹⁰⁵ 1st Arctic Ministerial Conference, *Arctic Environmental Protection Strategy* (Rovaniemi, Finland: 1st Arctic Ministerial Conference, 1991), 2, http://library.arcticportal.org/1542/1/artic_environment.pdf.

intergovernmental forum for addressing issues related to the Arctic region.”¹⁰⁶ The members of the Arctic Council include the eight Arctic states of Canada, Denmark, Finland, Iceland, Norway, Sweden, the Russian Federation, and the United States, as well as representation from Arctic permanent participant indigenous groups and Arctic Observer States.¹⁰⁷ Although the establishment of the Arctic Council was consequential to developing an Arctic regional identity within international politics,¹⁰⁸ this era would see the United States as a “reluctant Arctic power,” with U.S. national attention elsewhere around the world and U.S. unipolarity guaranteed as the nation enjoyed a period of military, economic, and technological superiority over the rest of the world.

However, in 2007, Russia reinvigorated U.S. national security interest in the Arctic by planting a Russian flag on the seabed of the North Pole, indicating to the international community its attempted claim of oil and gas reserves worth billions of dollars along the Lomonosov Ridge in the middle of the Arctic Ocean.¹⁰⁹ This symbolic gesture reinforced to the world Russia’s inherent Arctic interests and foreshadowed Russia’s reemergence as an active regional power. In response, the Bush administration signed the 2009 National Security Presidential Directive (NSPD) 66, which largely established the current U.S. framework related to the Arctic and specified the broad national security interests in the Arctic region to include: “missile defense and early warning; deployment of sea and air systems for strategic sealift, strategic deterrence, maritime presence, and maritime security operations; and ensuring freedom of navigation and overflight.”¹¹⁰

¹⁰⁶ “Office of Ocean and Polar Affairs: Arctic Region,” Department of State, accessed May 21, 2021, <https://www.state.gov/key-topics-office-of-ocean-and-polar-affairs/arctic>.

¹⁰⁷ Department of State, “Office of Ocean and Polar Affairs: Arctic Region.”

¹⁰⁸ Olav Schram Stokke, “Examining the Consequences of Arctic Institutions,” in *International Cooperation and Arctic Governance*, ed. Olav Schram Stokke and Geir Hønneland (New York: Routledge, 2007), 20.

¹⁰⁹ Tom Parfitt, “Russia Plants Flag on North Pole Seabed,” *The Guardian*, last modified August 2, 2007, <https://www.theguardian.com/world/2007/aug/02/russia.arctic>.

¹¹⁰ White House, *National Security Presidential Directive/NSPD – 66*, 3.

The Bush administration’s Arctic policy directive designated freedom of the seas as a top national priority and emphasized the contrasting geopolitical circumstances of the Arctic and Antarctic region. Furthermore, it codified the U.S diplomatic stance that the Northwest Passage within Canada’s EEZ and the Northern Sea Route (NSR) within Russia’s EEZ are straits used for international navigation and that international law applies to passage through those straits.¹¹¹ This provided a clear U.S. stance on freedom of navigation enforcement within the Arctic and reinforced the U.S.’s desire to ensure maritime passages were secured for global trade.

This policy directive presented the most robust U.S. Arctic policy framework of any previous administration and demonstrated to the international community the U.S.’s stance that environmental protection and international cooperation in the Arctic should be prioritized, but also established that the United States was “prepared to operate either independently or in conjunction with other states to safeguard” U.S. strategic interests in the region.¹¹² Critically, the policy also highlighted key U.S. strategic capability gaps within the Arctic, asserting the need to: develop greater capabilities and capacity to protect U.S. sovereignty in the Arctic region; increase Arctic *maritime domain awareness*; and project U.S. maritime and aircraft presence in the Arctic reliant on a resilient *C3ISR* architecture to support essential U.S. interests [emphasis added].¹¹³ As previously mentioned in chapter one of this thesis, these strategic capability gaps would be reiterated in the key findings of the GAO assessment of the DOD’s 2011 Arctic Report and provide the genesis for future Arctic policy and investment development.

D. SPACE COLLABORATIVE CAPACITY

Since the 2011 NSSS, the U.S.’s space policy has argued for the pursuit of mutually beneficial agreements with key partners to “increase interoperability, compatibility, and integration of partner nations into appropriate DOD and [intelligence community]

¹¹¹ White House, 3.

¹¹² White House, 3.

¹¹³ White House, 4.

networks to support information sharing and collective endeavors, taking affordability and mutual benefit into account.”¹¹⁴ The Obama administration’s 2013 National Strategy for the Arctic Region and subsequent 2016 implementation framework built on the Bush administration’s policy objectives, but emphasized collaborative and innovative approaches to strengthen international cooperation as well as the advancement of U.S. national security interests within the Arctic. Moreover, the Obama administration’s 2013 National Strategy for the Arctic Region and 2010 NSP provided the guiding principles to establish a U.S. cooperative space strategy for the Arctic region. The Arctic strategy states, “Just as a common spirit and shared vision of peaceful partnership led to the development of an international space station, we believe much can be achieved in the Arctic region through collaborative international efforts, coordinated investments, and public-private partnerships.”¹¹⁵

DOD joint doctrine highlights the importance of security cooperation initiatives, as they strengthen and expand the existing network of U.S. allies and partners and provide “ways and means to help achieve national security and foreign policy objectives.”¹¹⁶ Likewise, the 2010 NSP directed the expansion of international cooperation on mutually beneficial space activities to “broaden and extend the benefits of space...[and] enhance collection and partnership in sharing of space-derived information.”¹¹⁷ The subsequent 2011 NSSS and 2013 National Strategy for the Arctic Region further stressed the need to build Arctic awareness by strengthening international cooperation in space activities. It emphasized that the harsh, remote, and complex operating environment make the Arctic well-suited for collaborative efforts, and that space operations are uniquely qualified to meet the emerging threats.¹¹⁸

¹¹⁴ DOD and DNI, *National Security Space Strategy (Unclassified Summary)*, 9.

¹¹⁵ White House, *National Strategy for the Arctic Region* (2013), 4.

¹¹⁶ Joint Chiefs of Staff, *Security Cooperation*, JP 3-20 (Washington, DC: Joint Chiefs of Staff, 2017), V, https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_20_20172305.pdf.

¹¹⁷ White House, *National Space Policy of the United States of America*, 4.

¹¹⁸ White House, *National Strategy for the Arctic Region*, 8.

The shared imperative and responsibility for space security within the Arctic transcends the capabilities of individual nations, due to limited budgets and competing global requirements. As the most advanced spacefaring nation within the Arctic, the United States will pay disproportionately in providing space operations and associated capabilities to provide increased communications, navigation, and awareness of the Arctic. However, assisting “allies and partners in developing, acquiring, and employing their own space capabilities that complement and augment U.S. capabilities and contribute to coalition space operations”¹¹⁹ can advance U.S. national security interests and build coalition resiliency in the Arctic. In line with the Obama administration’s space policy objectives, and as an evolutionary shift in strategic thinking, U.S. space policy now seeks to increase “allied and partner access to and sharing of national security-related space technologies, information, and equipment required to support cooperative activities when advantageous to U.S. national security interests.”¹²⁰ This shift in strategic engagement should help build space capacity and capability and expand collective security by enhancing communication, navigation, and awareness within the Arctic if advantageous to their domestic strategic objectives.

The realization of the potentiality of collective space security through shared multi-domain awareness and an extended communications architecture also demands new approaches to public-private partnerships in the space domain. A 2019 intelligence community threat assessment stated, “We continue to assess that the expansion of the global space industry will further extend space-enabled capabilities and space situational awareness to government, nonstate, and commercial actors in the next several years. All actors will increasingly have access to space-derived information services, such as imagery; weather; communications; and positioning, navigation, and timing (PNT).”¹²¹ A collaborative space concept sees this as an opportunity to support and facilitate civil,

¹¹⁹ Department of Defense, *Department of Defense International Space Cooperation Strategy*, 2.

¹²⁰ Department of Defense, 1–2.

¹²¹ Daniel R. Coats, Director of National Intelligence, “Worldwide Threat Assessment of the Intelligence Community” (Washington, DC: Office of the Director of National Intelligence, 2019), 16, <https://www.dni.gov/files/ODNI/documents/2019-ATA-SFR---SSCI.pdf>.

commercial, defense, and multinational partners and leverage their shared resources and broader situational awareness to enhance Arctic regional security.¹²² In August 2020, James DeHart, the U.S. Coordinator for the Arctic, stated, “if you look at what is happening in our system over the last couple of months, you will see that we are launching a comprehensive and an integrated diplomatic approach and engagement in the Arctic region,” and that “in a few years, people will look back at this summer [of 2020] and see it as an important pivot point, a turning point, with a more sustained and enduring attention by the United States to the Arctic region.”¹²³ However, although the current geostrategic environment has refocused U.S. attention on the Arctic due to polar great power competition, will the United States translate this to the space domain? For this to occur, the United States must turn intent into action and rhetoric into reality.

E. ANALYSIS

This analysis reviews the preceding four parts of this chapter to develop an understanding of how the United States might build and benefit from additional space collaborative capacity within the Arctic region.

Based on part A, the United States has acknowledged the evolving geostrategic environment within the Arctic and has recognized the geostrategic importance the region contributes to U.S. national security of the homeland and abroad, environmental monitoring, and ensuring freedom of the seas for trade, aid, and combat projection. Space-based solutions provide an economic, responsive, and reliable medium to mitigate U.S. strategic capability gaps within the region, but it is clear the United States must do more to address resource shortfalls. The Arctic provides a significant economic resource for the United States to exploit, and continued neglect of the region will likely see U.S. competitors fill the vacuum left by U.S. hesitancy.

¹²² Gordan E. Van Hook, “Maritime Security Consortiums,” in *Conflict and Cooperation in the Global Commons*, ed. Scott Jasper (Washington, D.C.: Georgetown University Press, 2012), 173.

¹²³ Hilde-Gunn Bye, “The U.S. Is Launching a Comprehensive Diplomatic Approach in the Arctic Region, Says Top-Level Official,” High North News, last modified November 23, 2020, <https://www.highnorthnews.com/en/us-launching-comprehensive-diplomatic-approach-arctic-region-says-top-level-official>.

Based on part B, this complex geostrategic environment will challenge the United States to maintain its competitive advantage over both Russia and China within the Arctic. The United States is in an era of polar great power competition. Consequently, the United States requires a careful balancing of competition on geopolitics, economics, technology, and infrastructure within the Arctic with cooperation particularly on economic aspects where Arctic allies and partners depend on China and Russia for economic growth. A comprehensive cooperative space strategy for the Arctic would need to consider these complex relationships while balancing Arctic allied and partner political objectives and strategic goals. Both China and Russia are indispensable economic opportunities while also a tangible threat within the Arctic. While Arctic allies and partners have maintained a policy of engagement with China and Russia within the Arctic, the United States must weigh the strategic calculus of leveraging a cooperative space strategy in the Arctic to mitigate its strategic capability gaps and assert its influence within the region. This could be complicated by the external security environment, economic relations, and domestic politics of not only its Arctic allies and partners, but domestic civil, commercial, and defense issues within the United States as well.

Based on part C, although the United States has articulated national Arctic policies since the early 1970s, many of the policies have only been rhetoric deep with little substance delivered on grand promises. There has been a recent strategic shift with the reemergence of great power competition back to viewing the Arctic as a geostrategic theater for defense similar to the days of the Cold War. The Bush administration's acknowledgement of the importance of maintaining freedom of the seas and differentiating the two polar regions provided a focused federal effort towards the Arctic. It is clear from the consistent political messaging across various presidential administrations that the United States has more in common with its Arctic allies and partners than opposed. This should contribute significantly to building collaborative capacity amongst partners due to a shared purpose and strategy amongst representatives.

Based on part D, the United States has built the necessary structure and policy required to build space collaborative capacity. The 2010 NSP and subsequent 2011 NSSS, along with the associated 2013 National Strategy for the Arctic Region, established the

guiding principles for collaborative space activities within the region through a diplomatic lens of cooperation and mutual benefit to Arctic allies and partners. Additionally, strategic guidance fosters lateral mechanisms which encourage information sharing and collaborative learning to enhance space security cooperation within the Arctic. Furthermore, U.S. political leadership continued the momentum established during the Bush administration. The Obama administration refined the guidance and proposed implementation strategies, and the Trump administration continued to foster a spirit of cooperation with Arctic allies and partners through both the Department of Homeland Security and the State Department. Although recent U.S. domestic policies did create a period of friction amongst Arctic allies and partners during the Trump administration, longstanding cooperative engagement in Arctic intergovernmental forums continued bilateral, multilateral, and regional collaboration amongst Arctic allies and partners.

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III. COMPLEXITY OF SPACE COLLECTIVE ACTION

This chapter analyzes the challenges and opportunities of space collective action within the Arctic region, to include rationales for space collective action as well as the technical and geopolitical barriers to building space collaborative capacity, due to the harsh operating environment and geopolitical effects of broader strategic relationships. As previously mentioned in Chapter One of this thesis, the United States has significant capability gaps within the Arctic. As noted by the Arctic Collaborative Environment (ACE) report, “organizations with operational responsibility in the Arctic lack the capabilities necessary to meet emerging challenges and operational requirements in the region.”¹²⁴ This chapter seeks to identify rationales and common barriers to space collective action and highlight operational challenges and opportunities in implementing space solutions within the region. This chapter has two main parts separated by overarching themes. The first part assesses rationales for space collective action as they apply to the Arctic region. The second part describes the difficulties of building space collaborative capacity and identifies five common barriers to space collective action leveraging commonalities from research as a framework. The third part examines the preceding regional-specific opportunities and challenges identified to assess the likelihood of a cooperative space strategy materializing within the Arctic.

A. SPACE COLLECTIVE ACTION: RATIONALES AND OPPORTUNITIES

Since this thesis is seeking to answer how the United States might benefit from a cooperative space strategy for the Arctic, it is imperative to review rationales for space collective action and whether they apply to U.S. allies and partners within the Arctic region. As pointed out in the introduction to this thesis, to qualitatively evaluate the potential to build space collaborative capacity within the Arctic, this chapter leverages parts of the interorganizational collaborative capacity (ICC) model introduced by Hocevar as a

¹²⁴ Joseph Casas, Martin Kress, William Sims, Stephen Spehn, Talbot Jaeger, and Devon Sanders, “The Arctic Regional Communications Small SATellite,” in Nano-Satellite Symposium, NASA, November 20, 2013, 10, <https://ntrs.nasa.gov/citations/20140011670>.

“conceptual framework to define organizational design strategies that enable multiorganizational and multinational efforts” for space security.¹²⁵ This section leverages ICC design factors of purpose and strategy, people, and structure to analyze the domains that may contribute to space collective action specific to the Arctic region.¹²⁶ This section leverages these ICC design factors as a framework to assess rationales for space collective action to further the discussion of interorganizational space collaborative capacity within the Arctic.

1. Purpose and Strategy

The ICC model introduces the design factor of “purpose and strategy.” This encompasses felt need, strategic actions, and resource investment.¹²⁷ As previously covered, the United States has established national space and Arctic policies with the intended purpose of leveraging Arctic allies and partners to address national interests within the region. Through these recent strategic documents, policy roadmaps, and implementation plans, the United States has a defined U.S. Arctic strategy, but this has been insufficient to transform rhetoric into reality, as the United States still maintains the same strategic capability gaps within the region. The design factor is a combination of *purpose* and strategy (emphasis added). As concluded in a CSIS report on current challenges and new opportunities for cooperation in the Arctic from 2010, “The United States must now act to implement this strategy and identify the political will and accompanying resources today to accomplish its stated objectives.”¹²⁸ Unfortunately, similar to the GAO’s assessment of the DOD’s 2011 Arctic report, the report from 2010 has many relevant conclusions that continue today but lack the committed resources or political will to implement recommended changes. Although each of these reports does not

¹²⁵ Hocevar, “Building Collaborative Capacity for Maritime Security,” 135.

¹²⁶ Hocevar, 124.

¹²⁷ Hocevar, 124.

¹²⁸ Heather A. Conley and Jamie Kraut, “U.S. Strategic Interests in the Arctic: An Assessment of Current Challenges and New Opportunities for Cooperation,” a report of the Center for Strategic & International Studies Europe Program (April 27, 2010), 27, <https://www.csis.org/analysis/us-strategic-interests-arctic>.

explicitly address space collective action as a solution to addressing critical capability challenges within the Arctic, many of their conclusions remain relevant to building space collaborative capacity within the Arctic by leveraging allies and partners within the region that share interests in Arctic affairs.

So how does the United States build the political will to allocate resources to sufficiently address Arctic challenges and transform rhetoric into reality? Dr. Michael Gleason, a national security senior project engineer and national security space expert, from the Aerospace Corporation's Center for Space Policy and Strategy, and Charity Weeden, a fellow at the Canadian Global Affairs Institute, identify five critical rationales for alliances and partnerships to build closer space security collaboration.¹²⁹ Gleason and Weeden point out that space collective action provides collective deterrence, combined resources, information sharing, geographical advantage, and political and strategic legitimacy opportunities to member states. Although these opportunities offered by space collective action are not unique to the Arctic region, the uniqueness of the Arctic's geography contributes to the applicability of space solutions due to the harsh environment and its location on the Earth's poles.

First, Gleason and Weeden propose that alliances and partnerships within the space domain provide strategic deterrence. They argue that "allies and partners in security space activities contribute to the perception of U.S. strength and leadership, and thereby bolster strategic and conventional deterrence."¹³⁰ Previously introduced space power theories in Chapter One of this thesis, by Moltz and Lambakis, reinforce these concepts. The understanding that "attacking a coalition of countries, in addition to the United States, widens a conflict beyond the United States, [and] defense space partnerships make it more costly and complicated for an adversary to strike [space assets and capabilities],"¹³¹ reinforces the perception of U.S. strength within the region. These theories essentially

¹²⁹ Michael P. Gleason and Charity Weeden, "Alliance Rationales & Roadblocks: A U.S. – Canada Space Study," *The Aerospace Corporation: Center for Space Policy and Strategy* (April 2018), https://aerospace.org/sites/default/files/2018-05/US-Canada_0.pdf.

¹³⁰ Gleason and Weeden, 3.

¹³¹ Gleason and Weeden, 3.

argue that interoperability of partnered forces within the space domain creates a more resilient space network that complicates potential adversaries' decision-making calculus and reinforces the asymmetric advantage of the United States' alliance network over Russia and China.

Secondly, Gleason and Weeden assert that space collective action contributes additional resources to the United States' space architecture. The United States and its Arctic allies and partners have more capability and capacity within the space domain by operating together. They argue that "the space resources allies bring [,] improve deterrence by increasing space domain 'mission assurance,' which includes resilient capabilities, the ability to rapidly reconstitute lost capabilities, and operations to defend space capabilities."¹³² They further emphasize that "allies and partners may also offer niche space capabilities that are driven by domestic priorities and are otherwise unavailable to the United States."¹³³ These additional resources and capabilities can mitigate U.S. strategic capability gaps within the Arctic and provide an avenue for smaller space programs to contribute to a larger space alliance or bilateral partnership.

2. People

Another design factor the ICC model introduces is "people" which encompasses the individual, societal, and cultural collaborative potential to build space collaborative capacity.¹³⁴ As mentioned previously, the United States maintains considerable defense and diplomatic partnerships amongst the Arctic nations. The more similar the domestic policies and ideologies of states, the more likely they are to cooperate and partner with one another to build space collaborative capacity. The Arctic region is a key focus area of Canadian and Nordic foreign policies. A 2019 Congressional Research Service (CRS) report stated, "The Nordic countries are troubled by the environmental and geostrategic

¹³² Gleason and Weeden, 3.

¹³³ Gleason and Weeden, 3.

¹³⁴ Hovevar, "Building Collaborative Capacity for Maritime Security," 125.

implications of climate change in the Arctic.”¹³⁵ It goes on to say, “Like the United States, the Nordic countries are wary of enhanced Russian military and commercial activity in the Arctic, as well as China’s growing interests and investments in the region.”¹³⁶

Additionally, a 2018 NATO Strategic Communications Centre of Excellence (STRATCOM COE) report, emphasized that Canada sees itself as “a ‘responsible steward’ of Arctic governance and the guardian of its fragile eco-system.” The report goes on to say that “exercising national sovereignty and emphasising [sic] the regional rather than international nature of the ‘North’ has always been considered the cornerstone of Canadian Arctic policy.”¹³⁷ These shared concerns amongst the Nordic countries, Canada, and the United States of outside influence within the region and the need for environmental monitoring and enhanced domain awareness build shared grievances and a desire to collaborate with like-minded nations.

However, the Arctic security environment is incredibly complex due to the various interorganizational memberships of the Arctic states and the historical influence of the region’s two superpowers of Russia and the United States. To capture the full complexity of Arctic geopolitical issues is well beyond the scope of this section. However, building space collaborative capacity between the United States and its Arctic allies and partners contributes to solving many shared geostrategic concerns within the Arctic, including high-latitude communications, navigation, maritime domain awareness, weather forecasting, and environmental monitoring. Additionally, a CSIS article from 2021 on leveraging allies and partners within the Arctic highlighted several security and defense issues of convergence amongst the U.S. and its allies and partners within the region. Key among them were credible national defense capabilities, resilience in space capabilities, enhanced security cooperation, domain awareness, developing resilient infrastructure, and improving

¹³⁵ Kristin Archick, *The Nordic Countries and U.S. Relations*, CRS Report No. IF10740 (Washington, DC: Congressional Research Service, 2019), 2, <https://fas.org/sgp/crs/row/IF10740.pdf>.

¹³⁶ Archick, 2.

¹³⁷ NATO, *Arctic Narratives and Political Values: Russia, China and Canada in the High North*, prepared by the NATO Strategic Communications Centre of Excellence, ISBN: 978–9934–564–20–1, September 2018, 22; 24, <https://stratcomcoe.org/publications/arctic-narratives-and-political-values-russia-china-and-canada-in-the-high-north/116>.

crisis response and search-and-rescue capacity in the High North.¹³⁸ These critical issues within security and defense contribute to building space collective action within the region.

Furthermore, space collective action amongst U.S. allies and partners within the Arctic provides legitimacy and access for U.S. space operations and associated capabilities. Gleason and Weeden point out that space collective action provides political legitimacy through strategic engagements abroad and within domestic politics. They emphasize a generally accepted strategic truth, that “multilateral security activities generally have more legitimacy than unilateral action in the international community.”¹³⁹ Moreover, they emphasize that geography matters in space collective action. They point out the geographical advantages of space collective action stating, “Allies and partners allow U.S. forces on their territory which provides the U.S. the ability to project power, establish forward presence, and contribute to shaping the local and regional environment.”¹⁴⁰ These geographical advantages provide the United States access and proximity for space ground stations and counterspace capabilities.

3. Structure

The last design factor within the ICC model this section incorporates is “structure” which encompasses organizations and collaboration structures to support building space collaborative capacity.¹⁴¹ Fortunately for the United States, the Arctic region has substantial bilateral, multilateral, and interorganizational agreements combined with a historic cooperative spirit of engagement amongst the Arctic states on Arctic affairs. Although the Arctic Council is the premier interorganizational forum within the Arctic consisting of the eight Arctic states, the Arctic states are also members of NATO, the

¹³⁸ Rachel Ellehuus and Colin Wall, “Leveraging Allies and Partners,” Center for Strategic & International Studies, last modified January 28, 2021, 4, <https://www.csis.org/analysis/leveraging-allies-and-partners#:~:text=Introduction,regions%20that%20complement%20U.S.%20assets>.

¹³⁹ Gleason and Weeden, “Alliance Rationales & Roadblocks: A U.S. – Canada Space Study,” 4.

¹⁴⁰ Gleason and Weeden, 4.

¹⁴¹ Hocevar, “Building Collaborative Capacity for Maritime Security,” 125.

Nordic Defence Cooperation (NORDEFCO),¹⁴² ESA, and the European Union (EU), amongst other organizations and international forums. However, none of these organizations except for the Arctic Council focuses solely on Arctic affairs. These existing interorganizational forums provide the structure necessary to build space collaborative capacity within the Arctic. They support bilateral, multilateral, and intergovernmental collaboration efforts in terms of goals, constraints, and authorities.¹⁴³

Although the Arctic Council is the premier intergovernmental forum within the Arctic, it consistently avoids controversial issues, including politically charged defense and security challenges. Olav Schram Stokke, a research professor at the Fridtjof Nansen Institute in Norway, asserts that the Arctic Council has had a “niche orientation toward non-controversial matters like fact finding and capacity enhancement, rather than politically contested issues related to regulations of economic or military activity.”¹⁴⁴ However, the Council is responsible for multiple multilateral agreements amongst the Arctic states to include the 2011 “Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic”¹⁴⁵ and the 2017 “Agreement on Enhancing International Arctic Scientific Cooperation.”¹⁴⁶ These agreements prove the Arctic Council provides a legitimate structure to build collaboration.

However, the Council’s reluctance to focus on potentially controversial defense issues could possibly prevent any significant space collaborative capacity agreements that address specific U.S. defense capability shortfalls. This diplomatic reality means that the United States will likely have to seek other intergovernmental forums or create additional

¹⁴² NORDEFCO consists of Denmark, Finland, Iceland, Norway, and Sweden as member states.

¹⁴³ Høevar, “Building Collaborative Capacity for Maritime Security,” 125.

¹⁴⁴ Olav Schram Stokke, “International Institutions and Arctic Governance,” in *International Cooperation and Arctic Governance*, ed. Olav Schram Stokke and Geir Hønneland (New York: Routledge, 2007), 177.

¹⁴⁵ Arctic Council, “Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic,” signed at the Nuuk, Greenland Ministerial meeting, May 12, 2011, <https://oaarchive.arctic-council.org/handle/11374/531>.

¹⁴⁶ Arctic Council, “Agreement on Enhancing International Arctic Scientific Cooperation.”

forums to promote space collective action in the Arctic. As concluded in a 2010 CSIS report on current challenges and new opportunities for cooperation in the Arctic, the United States must first “clarify its preferred institutional framework for working with the Arctic littoral states and other nations interested in the region.”¹⁴⁷

Should the United States seek bilateral negotiations with Arctic allies and security partners or leverage interorganizational talks with NATO,¹⁴⁸ ESA, or NORDEFCO? Bilateral negotiations provide an avenue to advocate for Arctic agreements with stakeholders that contribute to Arctic affairs without building consensus amongst the group. However, the complexity of U.S. Arctic allies and partners’ membership in a multitude of organizations complicates negotiations and further exacerbates challenges in building space collaborative capacity. Conversely, the intergovernmental forums provide significant resources and capacity that offer a more systematic approach to addressing space collaborative capacity.

Does the United States need to create a joint task force under USNORTHCOM specific to the Arctic to focus on Arctic affairs or stand back up the NATO Allied Forces Northern Europe (AFNORTH) command stood down in 1994? These arrangements would provide a military regionally aligned command explicitly focused on addressing Arctic challenges within the space domain. As the most prominent space power within the Arctic, the United States should take a leadership role in determining the structure that it believes will create the most significant potential to building space collaborative capacity within the Arctic if it aligns with its national interests.

As the premier space power within the Arctic, Gleason and Weeden argue that the United States must project strength by leading and supporting coalition space collective action and drive “the development of interoperable and resilient systems and capabilities.”¹⁴⁹ Whether the United States builds space collaborative capacity through

¹⁴⁷ Conley and Kraut, “U.S. Strategic Interests in the Arctic: An Assessment of Current Challenges and New Opportunities for Cooperation,” 26.

¹⁴⁸ NATO consists of the Arctic nations of Canada, Denmark, Iceland, Norway, and the United States.

¹⁴⁹ Gleason and Weeden, “Alliance Rationales & Roadblocks: A U.S. – Canada Space Study,” 3.

bilateral, multilateral, or intergovernmental engagement is irrelevant if the result addresses strategic shortfalls within the region. However, offering incentives and rewards to its allies and partners through space and security related benefits could assist in building space collaborative capacity within the Arctic and create strategic deterrence, greater resources, and a more resilient space network amongst Arctic allies and partners.

B. BARRIERS TO SPACE COLLECTIVE ACTION

The third hypothesis presented in Chapter One of this thesis proposed that a more robust Arctic cooperative space strategy will fail to materialize due to a combination of regional-specific challenges. Although the United States has acknowledged the need to build space collaborative capacity in the Arctic through national space policies, and DOD and Department of Homeland Security (DHS) strategies,¹⁵⁰ there are still significant challenges to overcome in implementing a comprehensive space cooperative strategy. Even if Arctic states seek to implement space collective action initiatives in good faith, there are still substantial roadblocks that inhibit alliance formation, burden sharing, and collaboration within the space domain. This section identifies five common barriers to building space collaborative capacity related to the Arctic region that were consistent themes from the author's research. These common themes consisted of political, organizational, technological, economic, and cultural barriers.

Gleason and Weeden reinforce these barriers to cooperation and collaboration within their research, acknowledging the challenges of legal and policy constraints, organizational complexities, technological disparities and inter-operability limitations, budgeting and burden sharing, and cultural issues as common barriers to building space collaborative capacity.¹⁵¹ Additionally, they point out that the relative significance of each of these barriers for bilateral, multilateral, and intergovernmental cooperation within the space domain varies depending on the countries involved. Furthermore, they state that “an

¹⁵⁰ Department of Homeland Security, *Strategic Approach for Arctic Homeland Security* (Washington, DC: U.S. Department of Homeland Security, 2021), 22, https://www.dhs.gov/sites/default/files/publications/21_0113_plec_dhs-arctic-strategy_0.pdf.

¹⁵¹ Gleason and Weeden, “Alliance Rationales & Roadblocks: A U.S. – Canada Space Study,” 2.

appreciation for these roadblocks can help the coalition to anticipate where problems will arise and help prioritize efforts to overcome them.”¹⁵² If the United States seeks to build a cooperative space strategy for the Arctic region, it needs to understand these challenges and mobilize resources necessary to establish practical cooperation based on mutual benefit and the geostrategic realities of the region.

1. Political

The first common barrier to building space collaborative capacity within the Arctic is the political barrier inclusive of domestic legal and policy constraints, the current multipolar international system, and political inconsistency. Leavitt points out that building political mobilization is necessary to drive space collective action. According to Leavitt, political mobilization starts by recognizing shared grievances, appropriately framing narratives, leveraging political opportunities, and mobilizing the resources required to achieve the desired objective.¹⁵³ The United States has recognized the shared grievances by prioritizing strategic areas for engagement, and has promulgated strategic guidance to frame the narrative of the geostrategic importance of the Arctic. Additionally, as previously discussed, the United States has begun to leverage the expansion of Russian military presence and increase in Chinese economic investment in the region as political opportunities for engagement. However, thus far, the United States has been unable to mobilize the necessary resources to meet its stated objectives. This section examines the political barriers preventing the required allocation of resources and highlights potential avenues for future engagement.

Gleason and Weeden point out that legal and policy constraints are often inhibiting factors in space collaborative initiatives. They state, “In some cases, allied collaboration is discouraged or blocked by domestic law, regulation, and political factors including industrial base and trade strategies that are embedded in domestic laws and regulations.”¹⁵⁴

¹⁵² Gleason and Weeden, 5.

¹⁵³ Leavitt, “Problems in Collective Action,” 27.

¹⁵⁴ Gleason and Weeden, “Alliance Rationales & Roadblocks: A U.S. – Canada Space Study,” 5.

According to John Hoffner in an Aerospace Security report for CSIS, “While the United States has historically been both the world leader in space and the leading advocate for free markets and open trade, it has also been one of the only countries in the world to restrict exports of commercial satellites on the basis of arms control.”¹⁵⁵ He goes on to say that “Beginning in 1976, the United States has generally regulated commercial satellites as a defense article and...controlled exports through the United States Department of State’s International Traffic in Arms Regulations (ITAR) on the United States Munitions List (USML).”¹⁵⁶ These export controls significantly limited the ability of the United States to conduct cooperative space agreements and prevented space technology sharing with many of its allies. A 2007 report led by the Air Force Research Laboratory (AFRL), with support from the Department of Commerce’s Bureau of Industry and Security, concluded, “ITAR has either directly or indirectly precipitated the global competition and is a significant impediment to the United States space industry’s ability to market to foreign buyers.”¹⁵⁷ Furthermore, the regulations encouraged European nations to seek space autonomy and contributed to establishing ESA.

European space autonomy has led to ESA initiatives that are often redundant rather than complementary to U.S. space systems, creating a competitive rather than a cooperative model. A 2007 white paper published by the Space Foundation in Colorado Springs, Colorado, concluded that ITAR restrictions contributed to the United States “effectively ceding the dominant position in space that it has enjoyed for some time by allowing the expertise of the U.S. space industry to deteriorate...and allowed global competitors to catch up in the global aerospace marketplace.”¹⁵⁸ While this report is likely hyperbole considering the United States has maintained its dominant position in space, the reports

¹⁵⁵ John Hoffner, “The Myth of “ITAR-Free,” Aerospace Security: A Project of the Center for Strategic and International Studies, last modified May 15, 2020, <https://aerospace.csis.org/the-myth-of-itar-free/>.

¹⁵⁶ Hoffner, “The Myth of “ITAR-Free.”

¹⁵⁷ Hoffner, “The Myth of “ITAR-Free.”

¹⁵⁸ George Abbey and Neal Lane, “United States Space Policy: Challenges and Opportunities” (Cambridge, MA: American Academy of Arts and Sciences, 2009), 6, <https://www.amacad.org/sites/default/files/publication/downloads/spaceUS.pdf>.

conclude that the legal restrictions of ITAR diminished U.S. space collaborative capacity with its European Arctic allies and partners and degraded the integration of space systems. An example includes ESA's Galileo global navigation satellite system (GNSS). Although the EU and the United States would eventually sign an agreement in 2004 to mitigate signal duplicity and contamination, the Galileo program was initially seen as redundant and even dangerous to U.S. planners that felt the technology could be used by potential adversaries against U.S. forces or positions.¹⁵⁹ However, recent cooperative agreements have seen the Galileo satellites offer redundancy and increase mission assurance for U.S. Arctic allies and partners. Leveraging both global positioning signal (GPS) and Galileo PNT data contributes to navigation and search and rescue (SAR) functions in the High North.¹⁶⁰

Additionally, the current multipolar international system sees Russia, China, and the United States competing for influence in polar great power competition within the Arctic. This increased competition within the region complicates traditional U.S. Arctic allied and partner frameworks, creating uncertainty and impediments politically when it comes to the transfer of sensitive space information or minimizing near-peer competitor access to astrostrategic locations. The Arctic has seen an expansion of Chinese space ground infrastructure with Arctic allies and partners providing access and geographical advantage to Chinese space activities. According to Jana Robinson from the Prague Security Studies Institute, "China has sought to position itself as a stakeholder in the region...In the past decade, its interests [in the Arctic] have expanded, encompassing exploration, commercial, shipping, and space activities."¹⁶¹ China is establishing a global network of space ground infrastructure that provides geographic access and capability with increased download speeds and greater coverage area. China currently has its Arctic space

¹⁵⁹ White House, "Fact Sheet: U.S.-EU Summit: Agreement on GPS-Galileo Cooperation" (Washington, DC: White House, 2004), <https://georgewbush-whitehouse.archives.gov/news/releases/2004/06/20040626-8.html>.

¹⁶⁰ "FCC Approves Use of Galileo in the U.S." European Global Navigation Satellite Systems Agency (EGSA), last modified November 16, 2018, <https://www.gsa.europa.eu/newsroom/news/fcc-approves-use-galileo-us>.

¹⁶¹ Jana Robinson, "Arctic Space Challenge for NATO Emerging from China's Economic and Financial Assertiveness," *Joint Air Power Competence Centre (JAPCC) Journal* 30, (Spring/Summer 2020), 35, https://www.japcc.org/wp-content/uploads/JAPCC_J30_screen.pdf.

ground stations “in Kiruna (Sweden), Karholl (Iceland), Ny-Ålesund (Svalbard), and Longyearbyen (Svalbard), and plans to establish ones in Finland (Sodankyla) and Greenland (Nuuk).”¹⁶² Of note, Sweden’s state-owned space company running the Kiruna ground station stated in 2020 that it would not “renew contracts with China or accept new Chinese business, because of changes in geopolitics.”¹⁶³ Additionally, in 2017, China attempted to obtain three commercial airports in Greenland before the agreement was terminated due to concerns expressed by Denmark and the United States.¹⁶⁴ These examples highlight the complicated geopolitics of the region. Moreover, multipolar competition in the Arctic acts as a political barrier to U.S. space collective action that must be mitigated to facilitate space cooperative capacity.

Furthermore, political inconsistency about space collaborative initiatives is another political barrier to overcome. Knipfer points out that “Incorporating foreign partners into a space project provides it a level of political commitment that buffers it from cancellation, to the extent that domestic political leadership is unwilling to break international agreements.”¹⁶⁵ As space systems and acquisition programs often require significant resources and time to develop, changing political stances from one U.S. administration to the next significantly impacts building space collaborative capacity amongst Arctic allies and partners. Changing priorities of separate administrations have seen the political will to act on Arctic strategic initiatives fluctuate with domestic priorities elsewhere. As the Arctic only has approximately four million inhabitants across the eight Arctic states,¹⁶⁶ the

¹⁶² Robinson, “Arctic Space Challenge for NATO Emerging from China’s Economic and Financial Assertiveness,” 37.

¹⁶³ Jonathan Barrett and Johan Ahlander, “Exclusive: Swedish Space Company Halts New Business Helping China Operate Satellites,” Reuters, last modified September 21, 2020, <https://www.reuters.com/article/us-china-space-australia-sweden-exclusiv/exclusive-swedish-space-company-halts-new-business-helping-china-operate-satellites-idUSKCN26C21L>.

¹⁶⁴ Robinson, “Arctic Space Challenge for NATO Emerging from China’s Economic and Financial Assertiveness.”

¹⁶⁵ Knipfer, “International Cooperation and Competition in Space (Part 1).”

¹⁶⁶ “All About Arctic Climatology and Meteorology: Arctic People,” National Snow & Ice Data Center, last modified May 4, 2020, <https://nsidc.org/cryosphere/arctic-meteorology/arctic-people.html#:~:text=In%20total%2C%20only%20about%204,much%20as%20twenty%20thousand%20years.>

constituency demand from the domestic audience to political leadership is low. These political barriers demonstrate the challenges that the U.S. could have in implementing a coherent strategy amongst its Arctic partners.

2. Organizational

The second common barrier to building space collaborative capacity within the Arctic is the organizational barrier inclusive of structural consistency, and organizational culture and priorities. Gleason and Weeden’s research showed that organizational bureaucratic barriers specific to “organizational scale, priorities, rules, regulations, workflow processes, and organizational culture” are likely some of the most challenging barriers to space collective action.¹⁶⁷ Although the Arctic enjoys significant regional collaboration on several key issues, there is no established regional forum specific to space cooperation inclusive of the United States and its allies and partners.

Structural inconsistency among U.S. presidential administrations has seen coordination at the national level fluctuate across administrations. In July 2014, following the publication of the national Arctic strategy in 2013, then-Secretary of State John Kerry announced the appointment of retired Coast Guard Admiral Robert J. Papp Jr. as the first U.S. Special Representative for the Arctic. However, after the Obama administration ended in January 2017, the position was left vacant until July 2020, when the Trump administration eventually created a new post with James DeHart acting as the first U.S. Coordinator for the Arctic region.¹⁶⁸ These inconsistencies carried over into the space domain as well. The George H.W. Bush administration established the National Space Council through Executive Order 12675 to coordinate civil, commercial, national security,

¹⁶⁷ Gleason and Weeden, “Alliance Rationales & Roadblocks: A U.S. – Canada Space Study,” 5.

¹⁶⁸ The Office of the U.S. Coordinator for the Arctic Region leads and coordinates the advancement of U.S. interests in the Arctic related to safety and security, sustainable economic growth, and strengthening cooperation among Arctic States to perpetuate and defend the rules-based order in the region. Ronald O’Rourke et al., *Changes in the Arctic: Background and Issues for Congress*, 8–9.

and international space policy matters.¹⁶⁹ However, following the Bush administration, the Clinton administration disbanded the council, and the National Science and Technology Council (NSTC) absorbed its functions. The National Space Council would not return until the Trump administration re-established it in June 2017.¹⁷⁰ This organizational and political inconsistency at the executive level of government limited interagency coordination specific to space and the Arctic. Furthermore, these barriers complicated enduring partnership activities amongst Arctic allies and partners within the region as space activities were primarily absorbed into scientific and environmental collaboration focused on cognitive space collaboration rather than normative issues like multi-domain awareness, communications, remote-sensing, and national security collaboration.

In his study on international cooperation and competition in space, Cody Knipfer highlights a key organizational barrier to building comprehensive space collaborative capacity, noting that, “space cooperation is often limited to scientific and exploratory endeavors whose primary purposes are not distinctly political, military, or economic.” He concludes that “these projects do not provide the same direct competitive advantage that gains in political influence, economic power, or national security do.” Many of the current space collaborative initiatives within the Arctic can be characterized in the same manner with scientific and environmental priorities taking precedence in space collaboration. Two examples are ESA’s Polaris Initiative and the United States’ Interagency Arctic Research Policy Committee (IARPC) under the Office of Science & Technology Policy.

The Polaris Initiative, supported by ESA and EU, seeks to enhance space-based monitoring of the polar regions through the development of next-generation space infrastructure and the exploration of new sensors, orbital parameters, constellations, and integrated platforms, as well as increase collaboration with new user communities and

¹⁶⁹ James A. Vedda, “National Space Council: History and Potential,” The Aerospace Corporation: Center for Space Policy and Strategy, November 2016, 3, <https://aerospace.org/sites/default/files/2018-05/NationalSpaceCouncil.pdf>.

¹⁷⁰ Vedda, 4–5.

develop new partnerships and joint initiatives.¹⁷¹ The 2016 study conclusions “are intended to help develop new space mission concepts for the polar regions that address evolving scientific and operational information needs.”¹⁷² Similarly, the IARPC consists of 16 agencies, departments, and offices across the U.S. federal government responsible for enhancing science and technology research in the Arctic.¹⁷³ Initially established in July 2010 as an interagency working group of the NSTC under the Committee on Environment, the IARPC now is a separate council under the Committee on Environment with the director of the National Science Foundation (NSF) as the chair. The IARPC creates the five-year Arctic Research Plans and coordinates science and technology integration within the Arctic across the interagency.¹⁷⁴ Although these scientific organizations provide the necessary governance framework within the Arctic for European and North American Arctic space collaboration, they focus mainly on scientific and environmental cognitive programs. However, it should be noted that although these efforts focus on scientific research and environmental monitoring, the duality of space-based systems and space ground infrastructure contribute to political, military, and economic space collaborative capacity within the Arctic. A satellite conducting remote sensing of ice flows and ocean temperatures, or a ground station providing weather and atmospheric coverage, can contribute or complement receiving data and information relevant to national security.

Furthermore, Gleason and Weeden highlight the scale and resources of U.S. space operations and related interagency organizations as an organizational barrier to building space collective capacity within the region.¹⁷⁵ For example, the Norwegian Space Agency

¹⁷¹ Polar View Earth Observation Limited, *Polaris: User Needs and High-Level Requirements for the Next Generation of Observing Systems for the Polar Regions*, prepared for European Space Agency, April 2016, i, https://www.arcticobserving.org/images/pdf/Board_meetings/2016_Fairbanks/14_Final-Summary-Report_2016-04-22.pdf.

¹⁷² Polar View Earth Observation Limited, *Polaris: User Needs and High-Level Requirements for the Next Generation of Observing Systems for the Polar Regions*, 7.

¹⁷³ Liz Weinberg, “About IARPC and IARPC Collaborations,” IARPC Collaborations, accessed May 7, 2021, <https://www.iarpcollaborations.org/about.html>.

¹⁷⁴ Weinberg, “About IARPC and IARPC Collaborations.”

¹⁷⁵ Gleason and Weeden, “Alliance Rationales & Roadblocks: A U.S. – Canada Space Study,” 5.

(NOSA), responsible for organizing Norwegian space activities and coordinating national space activities, has 40 employees and no assigned space personnel within its defense organizations.¹⁷⁶ Additionally, the National Space Institute at the Technical University of Denmark (DTU Space) has about 190 employees working with ESA and NASA.¹⁷⁷ Compare this to the nearly 17,000 employees working for NASA,¹⁷⁸ or the extensive interagency space organizations across the United States space enterprise. Gleason and Weeden point out that “this is a problem of scale.” Whether the United States seeks space collective action with its Arctic allies and partners or not, integrating people and resources to create “mirror-image” or similar positions, ranks, and organizational structure amongst its Arctic allies, apart from Canada, is likely unachievable in the near term. Leavitt clearly articulates this issue, stating, “Certainly, not all states have the desire or geographic, economic, or technological requirements to become [premier space powers].”¹⁷⁹ However, she points out that investment in space collaborative initiatives opens market opportunities, strengthens regional cohesion, and provides access to partner infrastructure.

3. Technological

The third common barrier to building space collaborative capacity within the Arctic is the technological barrier inclusive of technology disparity, system compatibility, and data-sharing restrictions and limitations. Moltz’s research highlights the term “techno-nationalism,” commonly used by Joan Johnson-Freese, to characterize patterns of competition and cooperation. Techno-nationalism is characterized by seeking “technological autonomy rather than the cost savings to be achieved through a division of

¹⁷⁶ “More About The Norwegian Space Agency,” Norsk Romsenter: Norwegian Space Agency, accessed May 7, 2021, <https://www.romsenter.no/eng/About/More-about-the-Norwegian-Space-Agency>.

¹⁷⁷ “DTU Space – The National Space Institute,” DTU Space: National Space Institute, last modified February 27, 2021, https://www.space.dtu.dk/english/about_nsi#:~:text=DTU%20Space%20at%20The%20Technical,of%20experience%20with%20space%20science.

¹⁷⁸ “What is NASA?” NASA, last modified September 24, 2018, <https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-is-nasa-58.html>.

¹⁷⁹ Leavitt, “Problems in Collective Action,” 30.

labor with other spacefaring nations.”¹⁸⁰ Although the Arctic region has seen significant space program integration within the civil sector, cooperation within the security sector amongst spacefaring Arctic states as a region, or a separate supranational forum, has remained elusive. This can largely be attributed to the competition between the United States’ NASA and ESA with redundant capabilities sought after to ensure European autonomy from the United States. This techno-nationalism persists today with the dual space programs separated largely by United States-Canadian space defense partnerships in the North American Arctic and Canada-Nordic space civil cooperation in the European Arctic.

Additionally, Gleason and Weeden point out that, “U.S., allied and partner interoperability issues often result from incompatible technology, systems, networks, and data.” They go on to emphasize that “systems that were designed and built without consideration of allied participation not surprisingly are difficult to use in an allied construct.”¹⁸¹ As discussed in the previous chapter, space collective activities can reduce budgetary cost and increase programmatic and political sustainability of systems and programs while increasing interoperability and reducing redundancy and waste between programs. However, as pointed out in a study on managed international cooperation in space activities, Broniatowski argues that international cooperation must be explicitly incorporated from the outset of a regional or functional strategy. He argues that this enables coordination and collaboration prior to the start of new programs and enhances interoperability to create what Broniatowski terms “critical path redundancy.” This prevents one partner from hindering or preventing collaboration due to legal and policy constraints, technological disparity, or system incompatibility.¹⁸² As the preeminent space power within the Arctic, the United States could create a pathway for space integration and systems standardization by leading regional space collaborative initiatives within the

¹⁸⁰ Moltz, *Asia’s Space Race: National Motivations, Regional Rivalries, and International Risks*, 22.

¹⁸¹ Gleason and Weeden, “Alliance Rationales & Roadblocks: A U.S. – Canada Space Study,” 6.

¹⁸² D. A. Broniatowski, G. Ryan Faith, and Vincent G. Sabathier, “The Case for Managed International Cooperation in Space Exploration,” (Washington, DC: Center for Strategic and International Studies, 2006), 6, http://web.mit.edu/adamross/www/BRONIATOWSKI_ISU07.pdf.

Arctic's nascent and emerging space programs to mitigate regional capability gaps that align with domestic priorities.

Moreover, information sharing, or the dissemination of data, can be one of the most difficult challenges to overcome when creating space collaborative capacity amongst allies and partners. In his study on international cooperation and competition in space, Knipfer notes, "as partnership on a project often entails transfer of technology or knowledge, states are reluctant to 'give away' sensitive military or economic information and capabilities."¹⁸³ Additionally, Alan Scott, a retired U.S. Navy Captain and space policy expert, highlighted that "one of the most significant challenges to the development of an allied space ISR network is the establishment of a robust data archival and dissemination system."¹⁸⁴ Scott emphasized that dissemination of data was an issue of interoperability between systems and hardware and a significant security classification issue amongst allies and partners. However, he was optimistic that the United States could use previous Arctic space collective action models to build future space collaborative capacity.

Scott highlighted the data-sharing arrangements between the United States and Norway and Canada, stating, "Although operated exclusively by Norwegian personnel and administrated by the Norwegian Intelligence Service, the U.S.-developed Globus II radar is also part of the U.S. [space surveillance network (SSN)]. Another noteworthy example is an effort to integrate data from the Canadian Sapphire space-based optical sensor and several ground-based telescopes into the U.S. SSN."¹⁸⁵ Scott concluded that the "processes and procedures developed to integrate data from Globus II and the Canadian Surveillance of Space Project (SofSP) into the U.S. SSN could be expanded to include sensors from other nations."¹⁸⁶ The United States could use these examples and others as

¹⁸³ Cody Knipfer, "International Cooperation and Competition in Space (Part 1)," 6.

¹⁸⁴ Alan D. Scott, "Coalition Building in Space: Initial Technical Considerations and Potential Implementation Strategies" [Prepared as a supplement to the Defense Threat Reduction Agency's project on "Allied Security and an Integrated Satellite Network"] (August 2011), 10.

¹⁸⁵ Scott, "Coalition Building in Space: Initial Technical Considerations and Potential Implementation Strategies," 3.

¹⁸⁶ Scott, 4.

a framework to encourage additional partnership opportunities that align with national interest to expand information sharing amongst Arctic allies and partners within the space domain.

Furthermore, system compatibility is another barrier to space collective action within the Arctic. The 2013 ACE Joint Capability Technology Demonstration (JCTD)¹⁸⁷ clearly articulated this lack of compatibility amongst Arctic space activities, stating, “There exists no Arctic awareness, decision-support system to enable long-term environmental planning, near-term cooperative actions, and real-time responses to humanitarian, environmental, and security issues in the Arctic.”¹⁸⁸ The ACE recognized the issues with building space collaborative capacity within the Arctic and sought to address them through “an internet-based, open-access, Arctic-focused, environmental research and decision support system that integrates data from existing remote sensing assets with products from existing and new environmental models” to provide analysis of the environment across the region.¹⁸⁹ Although this program was only a technology demonstration, the program’s contributors understood the complexity, insufficient resources, and common grievances shared across the civil, commercial, defense, and interagency in addressing space collective action. A cooperative regional space concept could see this framework expanded across the civil, commercial, and defense sectors to incorporate the mosaic of sensors in and passing over the region.

¹⁸⁷ The Arctic Collaborative Environment was a “The NASA led joint DOD and NASA/Marshall Space Flight Center (MSFC) ACE project is an Office of Secretary of Defense JCTD between NASA Marshall, the U. S. Army Aviation and Missile Research Development and Engineering Center (AMRDEC) and the International Arctic Research Center, University of Alaska Fairbanks to enhance awareness and understanding of the Arctic environment in support of international and domestic research, disaster and humanitarian response situational awareness, operations, and education.” “Arctic Collaborative Environment,” Aurora College Research Institute, accessed April 16, 2021, <https://nwtresearch.com/research-projects/information-technology/arctic-collaborative-environment>.

¹⁸⁸ Casas, Kress, Sims Spehn, Jaeger, and Sanders, “The Arctic Regional Communications Small SATellite,” 7.

¹⁸⁹ “Arctic Collaboratory Environment (ACE),” The University of Alabama in Huntsville, accessed May 10, 2021, <https://www.itsc.uah.edu/home/projects/arctic-collaboratory-environment-ace>.

4. Economic

The fourth common barrier to building space collaborative capacity within the Arctic is the economic barrier, including burden sharing, budgeting disparity, and investment priorities. In his work on space policy in developing countries, Robert Harding points out that “the decision to invest in a national space policy has been predicated not only on the desire for obtaining these technological advances but, when the financial and geopolitical circumstances allow and/or dictate, to address the perceived national security needs of the state.”¹⁹⁰ The emerging geostrategic environment requires enhanced capabilities and capacity to address increased human activity and attention by great powers within the Arctic. Fortunately, there is a general consensus amongst U.S. allies and partners that space-based solutions provide the best medium to address these issues. However, Stavridis points out that, “While the northern European nations all have long traditions of engagement in the Arctic, they collectively lack sufficient resources, geopolitical influence, or populations to make a strong case for deep involvement at the level of Russia, Canada, and the United States.”¹⁹¹

This is further complicated by the economic impact of the COVID-19 pandemic on the region. Norway’s currency experienced a record collapse as oil prices plummeted and regional tourism fell by as much as 95 percent within the region.¹⁹² Heider Gudjonsson, the Icelandic chairman of the Arctic Economic Council, reported on the economic impact, stating, “If globalization slows down, the impact is felt twice as hard in the Arctic.”¹⁹³ Furthermore, Le Mièrè and Mazo point out in their research, “The Nordic nations are, by and large, seeing shrinking defence budgets and personnel numbers, which is being countered by the purchase of fewer numbers of high-tech equipment and greater regional

¹⁹⁰ Robert C. Harding, *Space Policy in Developing Countries: The Search for Security and Development on the Final Frontier* (New York: Routledge, 2013), 194.

¹⁹¹ Stavridis, *Sea Power: The History and Geopolitics of the World’s Oceans*, 251.

¹⁹² Pauline Pic, “Geography of Economic Recovery Strategies in Nordic Countries,” The Arctic Institute: Center for Circumpolar Security Studies, last modified January 21, 2021, <https://www.thearcticinstitute.org/geography-economic-recovery-strategies-nordic-countries/>.

¹⁹³ Pic, “Geography of Economic Recovery Strategies in Nordic Countries.”

defence coordination.”¹⁹⁴ While Le Mière and Mazo’s work was published in 2013, this trend is only beginning to alter slightly with incremental increases since 2016 in defense budgets complementing the changing geostrategic focus on the Arctic. Defense spending accounted for 1.1 percent of Sweden’s GDP in 2019 compared to around 2.5 percent at the end of the Cold War.¹⁹⁵ Sweden’s space budget totaled approximately 111 million dollars for ESA in 2019, accounting for about 75% of its total space budget.¹⁹⁶ Similarly, Norway’s defense expenditures went from around 2.8 to 1.6 percent in the same period, with the funding for space activities totaling approximately 154 million dollars in 2020.¹⁹⁷ Compared to the U.S. Space Force fiscal year 2021 budget of 15.2 billion dollars, these numbers are a fraction of the space expenditure of the United States.¹⁹⁸

Additionally, Gleason and Weeden illustrate the complexity of the U.S. budget and acquisition process. They highlight that, “Allies and partners try to align the timing of their contributions with U.S. timelines in order to maximize their contribution to burden sharing and justify their investments to their domestic political leaders and public.”¹⁹⁹ Additionally, their research points out that many of the Arctic nations do not possess military space programs and thus are unable to commit to long-term projects with sustained spending levels in space defense activities. These circumstances emphasize that if the United States seeks regional space collective action, it will likely have to take the lead to provide an avenue for Arctic allies and partners to contribute where they can. This will require a comprehensive approach to space collective action, as space defense expenditures

¹⁹⁴ Le Mière and Mazo, *Arctic Opening: Insecurity and Opportunity*, 91.

¹⁹⁵ “Military Expenditure (% of GDP) – Sweden, Norway,” The World Bank, accessed May 11, 2021, <https://data.worldbank.org/indicator/MS.MIL.XPND.GD.ZS?locations=SE-NO>.

¹⁹⁶ “Swedish National Space Agency,” Rymdstyrelsen: Swedish National Space Agency, accessed May 11, 2021, <https://www.rymdstyrelsen.se/en/>.

¹⁹⁷ The World Bank, “Military Expenditure (% of GDP) – Sweden, Norway”; Norsk Romsenter: Norwegian Space Agency, “More About The Norwegian Space Agency.”

¹⁹⁸ Charles Pope, Secretary of the Air Force Public Affairs, “Air Force’s Proposed \$169 Billion Budget Focuses on ‘Great Power Competition,’ Readiness, Establishing Space Force,” U.S. Space Force, last modified February 10, 2020, <https://www.spaceforce.mil/News/Article/2080145/air-forces-proposed-169-billion-budget-focuses-on-great-power-competition-readi/>.

¹⁹⁹ Gleason and Weeden, “Alliance Rationales & Roadblocks: A U.S. – Canada Space Study,” 6.

by the United States may have to be complemented by civil or scientific expenditures by an Arctic partner that does not share a similar dedicated space defense budget.

Moreover, Bleddyn Bowen, a lecturer in International Relations with research interests in space strategy and space power theory at the University of Leicester, argues that the United States must be “clearer on what it would prefer its allies to be spending on space, rather than just demanding its allies spend more.”²⁰⁰ Bowen encourages the United States to consider advising smaller U.S. allies and partners to increase collaboration on space capability development in areas of mutual benefit, rather than building duplicate or redundant space capabilities that add little value and capacity to a broad alliance or coalition space network.²⁰¹ Bowen further advocates that the United States should encourage smaller allies and partners “to invest in small satellite-based intelligence, surveillance, and reconnaissance (ISR) platforms, small polar launches, and Space Situational Awareness [systems and capabilities].”²⁰² Scott reinforces this argument stating, “existing SSA and ISR capabilities as described [within his work] can be leveraged to provide the foundation for development of an integrated allied space architecture to address those specific space mission areas.”²⁰³ The United States could leverage these niche capabilities and geographic advantages of Arctic allies and partners to address its strategic capability gaps within the region. This form of burden-sharing could open the doors for greater involvement from smaller space programs and expand the United States’ inventory of potential partners within the space domain to address niche program areas.

²⁰⁰ Bleddyn E. Bowen, “Allies in U.S. Space Strategy: An Agenda for Space in Post-Brexit Britain,” in *Space Strategy at a Crossroads: Opportunities and Challenges for 21st Century Competition*, ed. Benjamin Bahney (Washington, DC: Center for Global Security Research, Lawrence Livermore National Laboratory, 2020), 33, <https://cgsr.llnl.gov/content/assets/docs/space-strategy-at-a-crossroads.pdf>.

²⁰¹ Bowen, 32.

²⁰² Bowen, 32.

²⁰³ Scott, “Coalition Building in Space: Initial Technical Considerations and Potential Implementation Strategies,” 11.

Some examples of these niche capabilities are Sweden's future polar launch initiatives or Denmark's focus on small satellite procurement.²⁰⁴

Furthermore, as mentioned previously in Chapter Two of this thesis, Chinese economic competition with the United States for influence within the region has reduced the United States' percentage of trade, aid, and influence among the Arctic states compared to Chinese investment. From a trade perspective, although the five Nordic countries' main trading partners are member states of the EU, China accounts for a significant and growing percentage of their gross domestic product (GDP). For example, Norway's trade with China increased from 9.2 to 10.2 percent from 2013 to 2019.²⁰⁵ Although the United States' investment in Norway increased following the Obama administration's Arctic strategy in 2013, it still only accounted for 7.9 percent of Norway's imports by 2019.²⁰⁶ The trade disparity with Denmark is even more stark. China increased its trade with Denmark in the same period to 7.3 percent of imports and further invested heavily in Greenland, accounting for 21.7 percent of all exports.²⁰⁷ Compare that to the United States, only accounting for 3.4 percent of Danish imports in 2019.²⁰⁸ Although these percentages are only a snapshot of time, Chinese economic investment in the region continues to grow as the United States comparatively lags. Two exceptions to this are U.S. investment in Canada and Iceland, with U.S. trade still surpassing Chinese economic investment. However, due to Iceland's geostrategic importance along China's "Polar Silk Road," China signed a free trade agreement with Iceland in 2013, making it the first European country to

²⁰⁴ Andrew Parsonson, "Sweden Ups Investment to Bring Orbital Launches to Esrange by 2022," SpaceNews, last modified October 21, 2020, <https://spacenews.com/sweden-ups-investment-to-bring-orbital-launches-to-esrange-by-2022/>; "ESA's GomX-4B CubeSat Relaying Data Across Space from Danish Twin," The European Space Agency, last modified April 18, 2018, https://www.esa.int/Enabling_Support/Space_Engineering_Technology/ESA_s_GomX-4B_CubeSat_relaying_data_across_space_from_Danish_twin.

²⁰⁵ "Norwegian Foreign Trade in Figures," Santander Trade Markets, accessed May 12, 2021, <https://santandertrade.com/en/portal/analyse-markets/norway/foreign-trade-in-figures>.

²⁰⁶ Santander Trade Markets, "Norwegian Foreign Trade in Figures."

²⁰⁷ "Danish Foreign Trade in Figures," Santander Trade Markets, accessed May 12, 2021, <https://santandertrade.com/en/portal/analyse-markets/denmark/foreign-trade-in-figures>; "Greenland," OEC, accessed May 12, 2021, <https://oec.world/en/profile/country/grl>.

²⁰⁸ Santander Trade Markets, "Danish Foreign Trade in Figures."

do so, further complicating China's access to Arctic resources and geographic advantages.²⁰⁹

5. Cultural

The fifth common barrier to building space collaborative capacity within the Arctic is the cultural barrier, including Arctic identity, domestic policy, and national interests. Gleason and Weeden point out that cultural considerations must be considered when building space collective action, emphasizing that the United States should prioritize further understanding of Arctic allies and partners' domestic priorities to enhance space collaboration.²¹⁰ Additionally, Knipfer emphasizes that, "Countries are inherently self-interested; their activity in and use of space serves a distinct goal—political, economic, scientific, or national security—that brings them benefit, international competitive advantage, and justifies the costs and complexities involved in a space program."²¹¹ A literature review of alliance theory and coalition operations reinforces this theme. However, he acknowledges that even if allies pursue space cooperation out of self-interest, the partnership's benefits are significant and often of mutual benefit considering the multitude of rationales discussed earlier in this chapter.

Despite a reemergence of U.S. interests in the Arctic due to the rapidly changing environmental and geostrategic challenges, a recent EU report from 2020, on developing an updated EU Arctic policy, highlighted that "Recent surveys conducted in late 2019 reveal that Americans 'mildly disagree with the assertion that the United States is an Arctic nation with broad and fundamental interests in the region.' In fact, compared to 2017, fewer

²⁰⁹ Laine Škoba, "China-Iceland Free Trade Agreement," Library of the European Parliament, 130631REV1, September 12, 2013, [https://www.europarl.europa.eu/RegData/bibliotheque/briefing/2013/130631/LDM_BRI\(2013\)130631_REV1_EN.pdf](https://www.europarl.europa.eu/RegData/bibliotheque/briefing/2013/130631/LDM_BRI(2013)130631_REV1_EN.pdf).

²¹⁰ Gleason and Weeden, "Alliance Rationales & Roadblocks: A U.S. – Canada Space Study," 6.

²¹¹ Knipfer, "International Cooperation and Competition in Space (Part 1)."

people agreed with that assertion.”²¹² These surveys potentially exhibit the United States’ continued reluctance to assert itself as an Arctic power. Additionally, they will likely continue to challenge U.S. political leadership to transform recent rhetoric into reality. This cultural barrier within the United States’ own reluctance to relate and engage in Arctic matters highlights the challenges of creating the political will to address Arctic geostrategic challenges.

Additionally, Gleason and Weeden highlight that “differing priorities among bureaucratic stakeholders produces inertia that may not be transparent and is difficult to overcome.”²¹³ Whereas the EU Arctic states’ three main priorities within the Arctic remain soft power issues of climate change, sustainable development, and international cooperation, the United States has prioritized hard security issues within the region with the DOD in the lead.²¹⁴ Since July 2020, the DOD and DHS have published Arctic strategies for the Departments of the Army,²¹⁵ Navy,²¹⁶ and Air Force,²¹⁷ as well as the Coast Guard under DHS.²¹⁸ Additionally, the Arctic Domain Awareness Center (ADAC) leads space collaboration initiatives as a DHS Center of Excellence hosted through the

²¹² European Parliament, European Union, “In-Depth Analysis: A Balanced Arctic Policy for the EU,” Policy Department for External Relations, Directorate General for External Policies of the Union (July 2020), PE 603.498, 22–23, [https://www.europarl.europa.eu/RegData/etudes/IDAN/2020/603498/EXPO_IDA\(2020\)603498_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/IDAN/2020/603498/EXPO_IDA(2020)603498_EN.pdf).

²¹³ Gleason and Weeden, “Alliance Rationales & Roadblocks: A U.S. – Canada Space Study,” 5.

²¹⁴ European Parliament, European Union, “In-Depth Analysis: A Balanced Arctic Policy for the EU,” 43.

²¹⁵ Department of the Army, *Regaining Arctic Dominance* (Washington, DC: Department of the Army, 2021), <https://api.army.mil/e2/c/downloads/2021/03/15/9944046e/regaining-arctic-dominance-us-army-in-the-arctic-19-january-2021-unclassified.pdf>.

²¹⁶ Department of the Navy, *A Strategic Blueprint for the Arctic* (Washington, DC: Department of the Navy, 2021), <https://media.defense.gov/2021/Jan/05/2002560338/-1/-1/0/ARCTIC%20BLUEPRINT%202021%20FINAL.PDF/ARCTIC%20BLUEPRINT%202021%20FINAL.PDF>.

²¹⁷ Department of the Air Force, *The Department of the Air Force Arctic Strategy* (2020).

²¹⁸ U.S. Department of Homeland Security, *Strategic Approach for Arctic Homeland Security*.

University of Alaska.²¹⁹ The EU attributes this organizational cultural barrier as a tendency of U.S. policy to lean towards hard power initiatives due to the large infrastructure and budgets within the DOD. The EU Arctic report emphasizes the role of the DOD in Arctic collaboration, arguing that “this has to do with the American political system and the competition for funding within the armed forces, but it is also a reflection of who the main governmental Arctic actors are in the United States. Apart from the role played by the State of Alaska within the administration, it is mainly the Department of Defense.”²²⁰

Conversely, the EU reiterated its Arctic position stating, “hard security, while important, should not be included on the agenda of either the Arctic Council or NATO. Instead, it should openly discuss rules and norms that support a peaceful, healthy, prosperous, and sustainable Arctic.”²²¹ The EU relies on ESA and European Commission (EC) working through the Arctic Council to continue “dialogue and confidence building measures in existing frameworks.”²²² ESA objectives within the Arctic include strengthening European cooperation in space research and applications, and developing competitive space technologies and industrial structures aimed at cost effectiveness for the purpose of scientific and operational space applications.²²³ While the focus areas and their organization members are different, the EU and the United States have separated their Arctic space collaboration into two lines of effort: space-based systems focused on science and environmental monitoring, and global climate change and space solutions to address

²¹⁹ “ADAC Summary Overview,” The Arctic Domain Awareness Center: A Department of Homeland Security Center of Excellence, last modified April 9, 2021, <https://arcticdomainawarenesscenter.org/Downloads/FactSheets/9%20Apr%2021%20ADAC%20Summary.pdf>.

²²⁰ European Parliament, European Union, “In-Depth Analysis: A Balanced Arctic Policy for the EU,” 23.

²²¹ European Parliament, European Union, 43.

²²² European Parliament, European Union, 43.

²²³ Eric Morel de Westgaver, “Arctic and Space – ESA Perspective” (lecture, ESA Arctic and Space Workshop, Helsinki, Finland, September 6, 2016), https://esamultimedia.esa.int/docs/spaceforearth/02_ESA_Arctic_and_Space_Morel_ESA.pdf.

geopolitical and geoeconomic challenges within the region.²²⁴ The significant difference is the funding and focus the United States attributes to hard security issues within the region.

Furthermore, European Arctic allies and partners cannot be visualized as a homogenous entity. Canadian interests within the Arctic differ from European Nordic interests and each Nordic nation has its own domestic priorities. Admiral James Stavridis, U.S. Navy, (ret), former NATO Supreme Allied Commander Europe, provided his perspective in 2017 on the Arctic states' ability to collaborate, stating the Arctic states "will pursue their individual national agendas through both the European Union, in a NATO context, and via the offices of the Arctic Council."²²⁵ He goes on to say that "Each of the European Arctic nations has a slightly different set of issues in the Arctic, and at the moment they show little sign of cooperating collectively to establish a European Arctic position on anything."²²⁶ Further complicating the issue is that although ESA is the only research and development space agency of Europe, it is not the only space agency in Europe with Denmark, Finland, Norway, and Sweden all possessing national space programs (emphasis added).²²⁷ Harnessing this complex multinational and intergovernmental mosaic of Arctic allies and partners into a coherent, comprehensive cooperative strategy could be difficult.

C. ANALYSIS

The most challenging aspect of operating within the Arctic remains the brutal character of its climate and environmental challenges. The 2019 DOD Arctic Strategy describes the challenging operating conditions, stating, "The Arctic environment presents specific operational challenges that limit communications, including the harsh climate, vast

²²⁴ European Parliament, European Union, "In-Depth Analysis: A Balanced Arctic Policy for the EU," 43.

²²⁵ Stavridis, *Sea Power: The History and Geopolitics of the World's Oceans*, 251.

²²⁶ Stavridis, 252.

²²⁷ U.S. National Research Council, *U.S.-European Collaboration in Space Science* (Washington, DC: The National Academies Press, 1998), 33, <https://doi.org/10.17226/5981>.

distances, and atmospheric phenomena.”²²⁸ Due to the combination of the Earth’s tilt and the Arctic’s location at the polar region, communications, remote-sensing, PNT, and multi-domain awareness are limited due to a multitude of factors that have been studied by the scientific and technology community at length. Byers highlights that satellites and space ground infrastructure “are vital to Arctic communications, surveillance, navigation, search and rescue, weather forecasting, sea-ice monitoring, fishing, prospecting, and environmental research.”²²⁹ All the Arctic states have identified these issues as areas of strategic priority.²³⁰ However, literature on the challenges and rationales to achieve space collective action to address these issues is less understood.

Based on part A, the Arctic region possesses all the design factors necessary to build space collaborative capacity. However, bold and active leadership within the defense and government sectors, formalized partnership agreements, and incorporating systems engineering principles to space network and system acquisitions and planning are needed to further develop space collective action within the region.²³¹ The design factors presented within this section provides a framework for planners to understand better the rationales and opportunities of space collective action within the Arctic. Incorporating these principles into future implementation plans for space collaborative efforts could address U.S. strategic capability gaps and increase regional cohesion with international partners within the region.

This chapter has sought to identify rationales and common barriers to building space collaborative capacity to better understand the challenges and opportunities that need to be addressed to achieve space collective action within the region. Part B of this chapter highlighted political, organizational, technological, economic, and cultural barriers that must be overcome to implement a cooperative space strategy for the Arctic. While these

²²⁸ Department of Defense, *2019 DOD Arctic Strategy*, 9.

²²⁹ Michael Byers, “Arctic Security and Outer Space,” in *Scandinavian Journal of Military Studies* (2020), 3(1), 183–196, 183, DOI: <http://doi.org/10.31374/sjms.56>.

²³⁰ European Parliament, European Union, “In-Depth Analysis: A Balanced Arctic Policy for the EU,” 23

²³¹ Gleason and Weeden, “Alliance Rationales & Roadblocks: A U.S. – Canada Space Study,” 3.

challenges are significant, the United States has recognized shared interests amongst its Arctic allies and partners, has the organizational structure in place to formulate solutions, and has communicated its strategic capability gaps and desire for collaboration to build space collaborative capacity within the region. Creating future transparency and confidence-building measures for space activities assist in bringing allies and partners to the negotiating table to seek issues of mutual interests.

The 2017 DOD International Space Cooperation Strategy reinforces this concept, stating “Cooperation cannot be left as an afterthought in planning U.S. national security space activities but must instead be integrated from the beginning into every aspect of space planning.”²³² Incorporating U.S. space-based and space ground infrastructure within Arctic allied and partner space architectures provides system resiliency, redundancy, and deterrence if systems are integrated at the conception of programs rather than after implementation. The rationales and common barriers presented within this chapter highlight the necessity for the United States to lead space collective initiatives within the Arctic if it seeks to mobilize the necessary resources to achieve its objectives. No other Arctic state has the organizations, resources, and technology to create regional space collaboration without U.S. support.

²³² Department of Defense, *DOD International Space Cooperation Strategy*, 3; Gleason and Weeden, “Alliance Rationales & Roadblocks: A U.S. – Canada Space Study,” 2.

IV. COMPARATIVE CASE STUDIES

This chapter on Arctic allied and partner space activities provides two comparative case studies to assess the benefits to the United States of bilateral and regional space collective action within the Arctic. This chapter examines the space collaborative capacity of two spacefaring Arctic states: Norway and Denmark. Each country is analyzed in three parts, identified by a brief history of its space activity, motivations and key trends of its space programs, and areas of cooperation for building future space collaborative capacity in the Arctic. Additionally, NATO is assessed as a possible intergovernmental solution to building space collaborative capacity within the region. The lessons developed in this chapter for understanding Arctic allied and partner space collaborative capacity can be used for follow-on research and development of future space collaborative partnerships within the space domain.

A. NORWAY

This section analyzes Norwegian space activities to provide context on how their niche space-based capabilities and services can contribute to a U.S. cooperative space strategy in the Arctic. Norway has had a strong and cooperative national security space relationship with the United States since the beginning of the Cold War. As a founding member of NATO and a strategic national security ally of the United States, the United States and Norway share a commitment as NATO allies to Arctic security. Due to Norway's extensive history in space activities and its ideal geographical location in proximity to the Arctic, it serves as an ideal case study to assess the benefits for a formalized and comprehensive cooperative space strategy within the Arctic.

1. Brief History of Norway's Space Activity

According to an ESA report on the history of Norwegian space activities, Norway's space activities date back to the early 20th century. Due to Norway's geographic location in the High North, Norwegian early scientific research focused primarily on polar

geophysical studies, including atmospheric, oceanic, and auroral studies.²³³ From its inception, Norway's space activities included space collective action focused on Scandinavian, European, and transatlantic cooperation inclusive of the United States and Canada, in order to build space collaborative capacity.²³⁴ As early as 1917, the Norwegian town of Tromsø became a center for Norwegian space science research that continues today. Initial cooperation with the United States saw funding through the Rockefeller Foundation to support the opening of the Norwegian Institute for Cosmic Physics, in Tromsø in 1930 and the world's first Institute of Theoretical Astrophysics (IFTA) in Oslo, Norway by 1934.²³⁵

By January 1960, the Royal Norwegian Council for Scientific and Industrial Research (NTNF) established the Norwegian Space Research Committee.²³⁶ Creating a single national committee for space research provided an avenue for Norway to engage in space research cooperation with the United States. In a 1959 policy for space research collaboration, NASA declared that the United States would only cooperate internationally with countries possessing a "unified, civilian body responsible for the whole field of space research."²³⁷ By August 1962, this transatlantic cooperation saw Norway launch its first sounding rocket from its Andøya Rocket Range (ARR), a launch sponsored and financed by the Norwegian Defense Research Establishment (NDRE), the NTNF, and the United States military and NASA.²³⁸ The ARR, in the northern part of Norway, provided Norway with a geostrategic advantage in its negotiations with the United States and its European counterparts to expand the scientific exploration of the auroral zone.²³⁹

²³³ Ole Anders Røberg and John Peter Collett, *HSR-35 Norwegian Space Activities 1958–2003: A Historical Overview* (The Netherlands: The European Space Agency, 2004), 3, http://www.esa.int/esapub/hsr/HSR_35.pdf.

²³⁴ Røberg and Collett, 1.

²³⁵ Røberg and Collett, 3.

²³⁶ Røberg and Collett, 5.

²³⁷ Røberg and Collett, 5.

²³⁸ Røberg and Collett, 11.

²³⁹ Røberg and Collett, 7, 11.

The establishment of the ARR and the shift from scientific research to industrial space activities with military application saw the dissolution of the NTNF's Space Research Committee and the standup of the Committee for Space Activity.²⁴⁰ Although Norway felt that scientific space research was still necessary, ESA historical records reflect that "the use and development of space technology for purposes other than scientific research had gained importance."²⁴¹ This trend continues today, with Norwegian space activities primarily focused on the industrial application of space technologies rather than significant national funding to scientific prestige initiatives. The 2013 Norwegian national space policy emphasized that, "Our strengths lie in certain industrial niches and in the application of space-based services...A small country must prioritise its resources, and there would be little point in attempting to create a major national space industry or to resolve to send Norwegian astronauts into space."²⁴²

The need for space-based surveillance in its newly proclaimed expanded maritime exclusionary economic zone altered the cooperative space structure within Norwegian space activities.²⁴³ Norway could no longer cooperate with the United States solely through bilateral negotiations while avoiding direct membership in cooperative European space organizations. Competition from ESA on negotiations with the United States for Landsat ground terminals pushed Norway into closer ties to its European partners, eventually leading to ESA membership in 1987.²⁴⁴ ESA records highlighted that it would take more than bilateral negotiations between the United States and Norway to establish a Landsat station in Norway as ESA entered negotiations with NASA that competed against

²⁴⁰ Røberg and Collett, 11.

²⁴¹ Røberg and Collett, 11.

²⁴² Norwegian Ministry of Trade and Industry, *Between Heaven and Earth: Norwegian Space Policy for Business and Public Benefit* (Aurskog, Norway: Norwegian Ministry of Trade and Industry, 2013), 6, <https://www.regjeringen.no/contentassets/0307388a5ded4f50b408d3aa8c916cb1/en-gb/pdfs/stm201220130032000engpdfs.pdf>.

²⁴³ Røberg and Collett, 34.

²⁴⁴ Røberg and Collett, *HSR-35 Norwegian Space Activities 1958–2003: A Historical Overview*, 38.

Norwegian interests.²⁴⁵ Realizing that it could no longer conduct bilateral negotiations with the United States without ESA competition, Norway's space committees began to formalize relationships with ESA before full membership in the late 1980s. Norway could no longer abstain from European space organizations without potentially sidelining itself in future European partnerships or losing out to combined European space capabilities. Consequently, the Norwegian Space Centre (NSC) (now the Norwegian Space Agency (NOSA)) was established in 1987 in coordination with Norway's ESA membership and "given the task of coordinating national space-related efforts, especially within the European arena."²⁴⁶

Additional space structural developments took place within the early 1990s and early 2000s with the creation of the Research Council of Norway (RCN) and several limited liability companies within the Norwegian space sector. Established in 1993, the RCN was a consolidation of Norway's five research councils to concentrate national space policy initiatives.²⁴⁷ Norwegian space activities were privatized through limited liability companies. Some significant examples from ESA historical records include: the merger of ARR with the NSC in 1987 with Kongsberg Aero & Defence acquiring 10 percent ownership of the site; the merger of the Tromsø Satellite Station with the NSC in 1990; the establishment of EISCAT-Svalbard in 1994; the privatization of NTA with the creation of Telenor in 1995; and the construction and privatization of the Svalbard-satellite station (Svalsat) with the merger between Kongsberg Defence & Aerospace and the NSC to create Kongsberg Satellite Services AS (KSAT).²⁴⁸ These changes in Norwegian space structure were an effort to make the space scientific research infrastructure profitable while retaining national oversight. These changes would prove highly successful and form the modern space infrastructure for the Norwegian space industry.

²⁴⁵ Røberg and Collett, 34.

²⁴⁶ Røberg and Collett, 41.

²⁴⁷ Røberg and Collett, 41.

²⁴⁸ Røberg and Collett, 47–49.

2. Motivations and Key Trends

According to Norway's space policy from 2013, "most Norwegian space activities have been motivated by geographic factors. Norway is an elongated country, reaching far to the north, with a sea area more than six times larger than its land area."²⁴⁹ The policy goes on to emphasize that, "the applied use of navigation, communication and earth observation satellites has been emphasized in addressing needs related to ship traffic, fisheries, agriculture, offshore petroleum and the public supervision of maritime activities."²⁵⁰ Furthermore, its unique maritime energy activities have seen it play a leading role in space collaborative developments as well as international collaborative initiatives. Although Norway is a small country with a limited population size, it has an oversized effect due to its strong economic advantage through its high-tech industrial base and close security ties to NATO and the United States.

Norway's unique proximity to the polar region and its extensive maritime area of responsibility have significantly influenced its space activities and contributed to Norway as a gateway to the Arctic and the polar space above it. As highlighted in a comparative case study report of global space strategies from Bryce Space and Technology, "Given [Norway's] geographic location, low population density, and activities in the maritime and offshore energy sectors, Norway is a natural consumer of space services."²⁵¹ Norway's proximity to the polar region make it ideally suited for atmospheric observation, the hosting of space ground infrastructure, and serving as a launch location for polar-orbiting satellites. The Norwegian national space policy from 2013 further emphasized Norway's unique geographical advantage, stating, "Since the 1960s, the geographical advantages of Norwegian-hosted ground infrastructure have been exploited to develop space activities

²⁴⁹ Norwegian Ministry of Trade and Industry, *Between Heaven and Earth: Norwegian Space Policy for Business and Public Benefit*, 21.

²⁵⁰ Norwegian Ministry of Trade and Industry, 21.

²⁵¹ Bryce Space and Technology, LLC, *Global Space Strategies and Best Practices: Research Paper for Australian Government, Department of Industry, Innovation and Science* (Alexandria, VA: Bryce, 2019), 15, https://www.industry.gov.au/sites/default/files/2019-03/global_space_strategies_and_best_practices_-_research_paper.pdf.

now regarded as world class in certain sector niches.”²⁵² These geographical advantages and niche capabilities make Norway a strong candidate for additional space collective action with the United States to address space solutions in areas of mutual interests.

ESA historical records highlight the industrial focus on Norwegian space activities stating, “Space activity, in a broad sense, has been economically profitable for Norway since 1987...It was pointed out that Norway probably had more space activities than most other countries similar in population size and national gross product, and that this would continue to be the case in the foreseeable future.”²⁵³ Records indicate that, “by the year 2004, only the United States and France have had a higher turnover ratio per capita connected to space-related activities.”²⁵⁴ This is a remarkable accomplishment for a spacefaring nation with around 5.4 million inhabitants.²⁵⁵

Norway sees itself as an emerging spacefaring nation that provides unique and complementary space capabilities to the High North and the Arctic.²⁵⁶ Additionally, according to Norwegian Ministry of Defence, it seeks to keep its space activities “as civilian as possible, as military as required,”²⁵⁷ in line with its political objective as an international leader in space cooperation and collaboration while supporting allied nations in the Arctic. Recognizing its small population size and geographical advantages in the High North, Norway space activities seek to be “a leading space nation in the Arctic,” while focusing space activities on what is “strategically important, operationally required, and

²⁵² Norwegian Ministry of Trade and Industry, *Between Heaven and Earth: Norwegian Space Policy for Business and Public Benefit*, 77.

²⁵³ Røberg and Collett, *HSR-35 Norwegian Space Activities 1958–2003: A Historical Overview*, 45.

²⁵⁴ Røberg and Collett, 45.

²⁵⁵ “Norway Population 2021,” World Population Review, last modified June 6, 2021, <https://worldpopulationreview.com/countries/norway-population>.

²⁵⁶ Stig Nilsson, Colonel, Norwegian Ministry of Defence, “Norwegian MoD Space Program” (presentation, Nordic Defence Industry Seminar (NDIS), Stockholm Archipelago, Sweden, May 24, 2018), <https://soff.se/wp-content/uploads/2018/05/B.-Stig-Nilsson.pdf>.

²⁵⁷ Nilsson, “Norwegian MoD Space Program.”

financially possible.”²⁵⁸ According to the U.S. Department of Commerce, “The Norwegian space industry is rather modest on an international scale, with an annual turnover of USD 893 million in a USD 423.8 billion global market (2019).”²⁵⁹ However, Norway’s geographical advantage in proximity to the polar region makes it an ideal location for space ground infrastructure and space science research. The U.S. Department of Commerce further highlights that, “Norway has a competitive advantage of being located such that the ground infrastructure is optimal for satellites. Svalbard is geographically uniquely placed in relation to reading data from polar orbiting satellites.”²⁶⁰ The report also highlights Norwegian market leaders in key space activities with Andøya Space Center (ASC) (orbital launch and research), Telenor (communications), Nammo, (propulsion systems), and the Kongsberg group (polar TT&C ground stations).²⁶¹

Norway has begun to expand its international presence in space policy forums, as it sees itself as a lead advocate for maintaining a conflict-free space domain. However, despite Norway’s extensive space history, it only recently became a member of the Committee on the Peaceful Uses of Outer Space (COPUOS) in 2017.²⁶² During Norway’s first address to COPUOS in 2018, Norway outlined its space policy priorities, stating, “Norway’s space policy focuses on social benefits, industrial development, research and user needs. Through international cooperation and national initiatives, Norway aims to use

²⁵⁸ Nilsson, “Norwegian MoD Space Program.”

²⁵⁹ International Trade Administration, U.S. Department of Commerce, “Norway – Country Commercial Guide: Defense and Aerospace Technologies,” last modified December 11, 2020, <https://www.trade.gov/country-commercial-guides/norway-defense-and-aerospace-technologies>.

²⁶⁰ International Trade Administration, U.S. Department of Commerce, “Norway – Country Commercial Guide: Defense and Aerospace Technologies.”

²⁶¹ International Trade Administration, U.S. Department of Commerce, “Norway – Country Commercial Guide: Defense and Aerospace Technologies.”

²⁶² United Nations, General Assembly, *International Cooperation in the Peaceful Uses of Outer Space: Report of the Secretary-General*, A/RES/72/77 (14 December 2017), https://www.unoosa.org/res/oosadoc/data/resolutions/2016/general_assembly_71st_session/ares7277_html/N1742901.pdf.

space for the benefit of sustainable development in the Arctic.”²⁶³ However, the 2013 Norwegian space policy also highlights the Ministry of Defence’s extensive reliance on space and the need to continue to contribute to bilateral space cooperation with the United States. The space policy emphasizes that “the Norwegian Armed Forces, including the Coast Guard, use information gathered from earth observation, communications and navigation satellites. Their satellite data requirements are expected to become so extensive in the years ahead that they plan to acquire their own satellite capacity.”²⁶⁴

The early part of the 21st century has witnessed Norwegian bilateral cooperation with key partners within the space domain. Recent Norwegian initiatives have seen space collaboration with the EU, ESA, Canada, Scandinavia, and the United States. The Norwegian space policy highlights Norwegian Armed Forces involvement in security agreements with the United States for access to the Global Positioning System’s (GPS) military applications as well as security programs associated with the Galileo project.²⁶⁵ Additionally, according to an Organisation for Economic Cooperation and Development (OECD) report from 2019, modern Norwegian space activities largely focus on “space manufacturing, satellite operations and downstream applications. Norwegian space manufacturing companies supply components, equipment and subsystems to several European satellites and launchers.”²⁶⁶ NOSA points out that, “there are more than 150 satellites containing Norwegian technology in space.”²⁶⁷ The Norwegian focus on both industrially profitable space applications combined with its increasing reliance on space for defense will likely see Norwegian space activities attempt to exploit the dual use of space assets to the maximum extent. As reinforced by its space policy, “the United States

²⁶³ United Nations Office for Outer Space Affairs, *Norwegian Statement, 61st Meeting of COPUOS June 2018*, https://www.unoosa.org/documents/pdf/copuos/2018/hls/07_12E.pdf.

²⁶⁴ Norwegian Ministry of Trade and Industry, *Between Heaven and Earth: Norwegian Space Policy for Business and Public Benefit*, 70.

²⁶⁵ Norwegian Ministry of Trade and Industry, 70.

²⁶⁶ “Norway,” OECD Library, accessed April 15, 2021, <https://www.oecd-ilibrary.org/sites/c9916723-en/index.html?itemId=/content/component/c9916723-en>.

²⁶⁷ “A Brief Overview,” Norsk Romsenter: Norwegian Space Agency, accessed April 13, 2021, <https://www.romsenter.no/eng/Norway-in-Space/A-Brief-Overview>.

has been and remains Norway's most important partner in space."²⁶⁸ Norway's extensive space experience and its close ties to the United States and NATO will likely see bilateral space cooperation initiatives continue.

3. Areas of Cooperation

Norway has cooperated with the United States since the early 20th century from scientific collaboration to bilateral defense agreements. As a founding member of NATO and a key U.S. security partner within the Arctic, Norway could be the gateway to building a cooperative space strategy for the Arctic. Norway's recent long-term defense strategy from 2020 emphasizes, "Due to our geostrategic location, Norway has considerable responsibility at the northern flank of the Alliance. To meet this responsibility, Norway must maintain a present national military force, as well as significant surveillance and intelligence resources."²⁶⁹ This regional-focused message communicated directly towards U.S. strategic capability gaps within the Arctic is likely no accident, as Norway continues to advocate for additional NATO and U.S. involvement in the Arctic. The following mission areas can be identified as areas of cooperation between Norway and the United States to build space collaborative capacity within the region.

a. Communications

Since the 1960s, Norwegian space activities have focused on improving maritime communications within the Arctic, due to Norway's extensive maritime shipping fleet. In 1968, Norwegian space activities would reach what an ESA report termed a "decisive turning point."²⁷⁰ The end of the 1960s witnessed the Norwegian space efforts to industrialize telecommunications, focused on maritime communications. According to

²⁶⁸ Norwegian Ministry of Trade and Industry, *Between Heaven and Earth: Norwegian Space Policy for Business and Public Benefit*, 66.

²⁶⁹ Norwegian Ministry of Defence, *The Defence of Norway: Capability and Readiness: Long Term Defence Plan 2020* (Oslo, Norway: Norwegian Ministry of Defence, 2020), 6, <https://www.regjeringen.no/contentassets/3a2d2a3cfb694aa3ab4c6cb5649448d4/long-term-defence-plan-norway-2020---english-summary.pdf>.

²⁷⁰ Røberg and Collett, *HSR-35 Norwegian Space Activities 1958–2003: A Historical Overview*, 22.

ESA records, this would see Norway “strongly set out in the direction of defining telecommunication as the chief priority of the Norwegian space effort.”²⁷¹ This was primarily due to Norway’s extensive merchant fleet, which accounted for nearly 10 percent of the world’s shipping capacity, and the significant contributions of Norwegian industry in maritime communication equipment.²⁷² Space solutions were seen as a possible service to address the growing needs of the maritime industry that garnered Norwegian scientific, military, and commercial sector support.

By 1979, the Norwegian Telecommunication Administration (NTA) became one of the most significant contributors to the International Maritime Satellite Organization (Inmarsat). According to ESA records, of the 40 initial countries investing in the consortium, “Norway was the fourth largest investor in Inmarsat, with a share equivalent to its proportion of the world merchant fleet.”²⁷³ Additionally, according to an official press release from the Norwegian government, “Norway was actually the first country to utilise satellites for inland communication, particularly for the oil installation (sic) in the North Sea and for the Svalbard archipelago in the Arctic.”²⁷⁴ The focus of Norwegian space activities on high-latitude communications continues today as a viable area of mutual interest to build space cooperation between the United States and Norway.

Norway is the leading satellite communications provider within the Nordic countries specializing in broadband and maritime communications.²⁷⁵ Throughout its recent history, due to its location in the High North, Norway has relied on satellite communications. According to NOSA, “Satellite communication accounts for about 70%

²⁷¹ Røberg and Collett, 22.

²⁷² Røberg and Collett, 23.

²⁷³ Røberg and Collett, 25.

²⁷⁴ Norwegian Broadcasting Corporation, “The Norwegian Space Program 50 Years,” The Norway Post, last modified July 18, 2019, <http://norwaypost.no/index.php/business/general-business/27326-the-norwegian-space-program-50-years-27326>.

²⁷⁵ “Leading 10 Telecommunications Companies in the Nordic Countries as of June 2020, by Turnover,” Statista, accessed June 4, 2021, <https://www.statista.com/statistics/554307/nordics-top-20-telecommunication-companies-by-turnover/>.

of Norwegian space-related turnover.”²⁷⁶ In May 2021, Norway has four commercial communications satellites in geostationary orbit with an additional three satellites decommissioned in their graveyard orbit.²⁷⁷ These commercial satellites include the Thor series of satellites from the commercial telecommunications provider Telenor, which is one of Norway’s largest companies and a world leader in telecommunications focused on broadcast coverage of Scandinavia, Eastern Europe, and the Asian market.²⁷⁸ Telenor was one of the largest shareholders of Inmarsat prior to its recent sale, and remains the fourth largest shareholder in Intelsat, both of which are leading high latitude satellite communications companies.²⁷⁹ Data from the United Nations Office for Outer Space Affairs (UNOOSA) confirms that Thor satellites 1–3 are currently in their disposal or graveyard orbits with Thor 4–7 in geostationary orbit providing coverage of Scandinavia and the maritime corridors over the North Sea, Norwegian Sea, Baltic Sea, and the North Atlantic amongst other areas.²⁸⁰

Although its current constellation of commercial communications satellites resides in geosynchronous earth orbit (GEO), Norway is currently developing an Arctic highly elliptical orbit (HEO) high-speed broadband communications system that will service higher latitudes within the Arctic. According to Space Norway, which is a limited liability company owned by the Norwegian government, “Space Norway will cooperate with the satellite operator Inmarsat and the Norwegian Ministry of Defence to offer mobile broadband coverage to civilian and military users in the Arctic.”²⁸¹ It is advertised that,

²⁷⁶ “A Brief Overview,” Norsk Romsenter: Norwegian Space Agency, accessed May 24, 2021, <https://www.romsenter.no/eng/Norway-in-Space/A-Brief-Overview>.

²⁷⁷ United Nations Office of Outer Space Affairs (UNOOSA), “Online Index of Objects Launched into Outer Space,” accessed May 21, 2021, <https://www.unoosa.org/oosa/osoindex/>.

²⁷⁸ “Group Holdings,” Telenor Group, accessed May 14, 2021, <https://www.telenor.com/about-us/global-presence/group-holdings/>.

²⁷⁹ “Telenor Satellite,” Telenor, accessed May 14, 2021, <https://www.telenor.com/about-us/global-presence/group-holdings/>.

²⁸⁰ “Thor 7,” Satbeams, accessed May 14, 2021, <https://www.satbeams.com/satellites?norad=40613>.

²⁸¹ “Space Norway to Provide Satellite Based Arctic Broadband,” Space Norway, last modified July 3, 2019, <https://spacenorway.no/home/>.

“each of the two satellites will carry multiple payloads, and the system is scheduled to be operational for at least 15 years with users able to switch between current geostationary satellites and the HEO satellites.”²⁸² The projected launch date is in late 2022 with full coverage over the Arctic from 65 degrees North.²⁸³

Additionally, the HEO satellites are being developed in collaboration with the United States and as part of the U.S. Air Force’s enhanced polar system (EPS) military satellite project. In July 2019, Northrop Grumman announced that the “two Norwegian satellites will host the core components of the U.S. Air Force’s next generation satellite communications system for the Arctic.”²⁸⁴ A GAO report from 2018, estimated that the recapitalization payload could save the Air Force an estimated “\$900 million over free-flying satellites.”²⁸⁵ Additional reports highlights that the enhanced polar system recapitalization (EPS-R) payload program “will include two eXtended Data Rate (XDR) payloads and will fill a Protected SATCOM coverage gap in the North Polar Region until the Protected Tactical SATCOM and Evolved Strategic SATCOM polar variants are available in the 2030s (sic).”²⁸⁶ The GAO report emphasized that “this mission may be particularly important as it marks the first DOD payload intended for operational use on a commercial host.”²⁸⁷ This space collaboration initiative is witnessing bilateral partnership in a public-private commercial venture to address shared strategic challenges within the

²⁸² Space Norway, “Space Norway to Provide Satellite Based Arctic Broadband.”

²⁸³ Space Norway, “Space Norway to Provide Satellite Based Arctic Broadband.”

²⁸⁴ Strout, “How 2 Space Norway Satellites Will Help the Air Force in the Arctic.”

²⁸⁵ Christina Chaplain, *Military Space Systems: DOD’s Use of Commercial Satellites to Host Defense Payloads Would Benefit from Centralizing Data*, GAO-18-493 (Washington, DC: Government Accountability Office, 2018), 12, <https://www.gao.gov/assets/gao-18-493.pdf>.

²⁸⁶ “U.S. Air Force’s Enhanced Polar System MILSATCOM Project Completes Critical Design Review,” Spacewatch.Global, accessed April 12, 2021, <https://spacewatch.global/2019/12/u-s-air-forces-enhanced-polar-system-milsatcom-project-completes-critical-design-review/>.

²⁸⁷ Chaplain, *Military Space Systems*, 13.

Arctic. Other Arctic allies have taken note, with the Canadian Armed Forces also potentially investing in the services.²⁸⁸

Furthermore, Norwegian commercial nanosatellite provider GomSpace was awarded a contract by the Norwegian Defence Research Establishment (FFI) in June 2020 “to develop and deliver a military communications nanosatellite...The satellite is meant to demonstrate military tactical communications on the Ultra High Frequency (UHF) band from a polar Low-Earth Orbit (LEO).”²⁸⁹ According to GomSpace, “the primary mission objective is to demonstrate the military use and relevance of an Arctic satellite relay for tactical communication radios.”²⁹⁰ This emerging capability continues to leverage Norwegian expertise in low budget, high-technology space solutions that have the potential to address national Arctic challenges.

b. Launch Facilities

The Andøya Rocket Range (ARR) played a pivotal role in expanding Norway’s international space activities across its three cooperative arenas of Scandinavian, European, and transatlantic partnerships. According to official ESA historical documents, Norway decided not to join the European Launcher Development Organisation (ELDO) in 1961 or the European Space Research Organisation (ESRO) in 1962, as it “was neither convinced of the industrial benefits of ESRO nor of the necessity for Norwegian scientists to join the organization.”²⁹¹ However, ESA reports confirmed that Norwegian space scientists and

²⁸⁸ “Arctic Space: GLOBUS Radar in Norway for Arctic SSA; Space Norway Targets Military Contracts,” Spacewatch Europe: Business Intelligence about Space Activities, accessed May 13, 2021, <https://spacewatch.global/2018/11/arctic-space-globus-radar-in-norway-for-arctic-ssa-space-norway-targets-military-contracts/>.

²⁸⁹ Rachel Jewett, “GomSpace to Develop Norwegian Military Satellite,” last modified June 11, 2020, <https://www.satellitetoday.com/government-military/2020/06/11/gomspace-to-develop-norwegian-military-satellite/>.

²⁸⁹ Mike Gruss, “Canada Eyes \$2.4 Billion Arctic Satellite Communications Constellation,” SpaceNews, last modified June 30, 2016, <https://spacenews.com/canada-eyes-2-4-billion-arctic-satellite-communications-constellation/>.

²⁹⁰ Jewett, “GomSpace to Develop Norwegian Military Satellite.”

²⁹¹ Røberg and Collett, *HSR-35 Norwegian Space Activities 1958–2003: A Historical Overview*, 1, 8, 11.

researchers believed that “a launch site in northern Norway, easily accessible in the auroral zone, would make Norway an attractive ally for foreign scientists,” including European partners and the United States.²⁹² By 1965, the European Space and Sounding Rocket Range (Esrange) Special Project (ESP) was established through negotiations “between the Swedish Space Corporation, NDRE, the NTNF Space activity division and ESRO.”²⁹³ The ESP leveraged the geographical advantage of Norway and Sweden’s Andøya and Esrange (Kiruna, Sweden) launch facilities. The ESP established a regional space cooperative agreement between European partners, stating, “ESRO Member States would have access to Esrange and Andøya. It was acknowledged that the two launch sites supplemented each other; Andøya being better suited for certain experiments than Esrange.”²⁹⁴ This agreement continues today as the Esrange Andøya Special Project (EASP) within ESA, with participation from France, Germany, Norway, Sweden, and Switzerland.²⁹⁵

Additionally, the ARR played a significant role in Norway’s bilateral collaboration with the United States. According to ESA historical reports, by 1975, “Andøya became one of the most frequently used launch sites under the NASA international programme...representing nearly 10 percent of the sounding rockets launched outside of North America.”²⁹⁶ Today, this trend continues with NOSA advertising that Andøya remains “NASA’s most important launch facility for sounding rockets outside USA.”²⁹⁷ A Norwegian government report confirms, “more than 1000 research rockets have been launched from the range” since 1962.²⁹⁸

²⁹² Røberg and Collett, 12.

²⁹³ Røberg and Collett, 28.

²⁹⁴ Røberg and Collett, 28.

²⁹⁵ “Fifty Years of Esrange,” The European Space Agency, last modified October 25, 2016, http://www.esa.int/About_Us/ESA_history/Fifty_years_of_Esrange.

²⁹⁶ Røberg and Collett, *HSR-35 Norwegian Space Activities 1958–2003: A Historical Overview*, 28.

²⁹⁷ “A Longer Overview,” Norwegian Space Agency, accessed May 24, 2021, <https://www.romsenter.no/eng/Norway-in-Space/A-Brief-Overview/A-Longer-Overview>.

²⁹⁸ Norwegian Broadcasting Corporation, “The Norwegian Space Program 50 Years.”

After going through several modernization upgrades throughout the years and several name changes, the Andøya Space Center or Andøya Space is now advertised as an orbital launch facility for small satellites into polar and sun-synchronous orbits at launch inclinations ranging from 87.4 to 108 degrees.²⁹⁹ Although the Andøya Space Center or Andøya Spaceport hasn't achieved orbital launch as of May 2021, in 2018 the Norwegian commercial company Nammo did achieve an altitude of 104 km.³⁰⁰ This was an important achievement as it “was the first sounding rocket fully developed and built in Norway by the Norwegian company Nammo in partnership with the Norwegian Space Agency and ESA.”³⁰¹ Nammo's propulsion system is a hybrid motor rocket combining liquid and solid propellant that uses a non-toxic fuel with a non-explosive solid which lowers cost and increases safety in handling and manufacturing.³⁰² This is yet another example of Norwegian space activities providing low-cost solutions to address regional needs. Although the United States possesses abundant launch sites to include a polar launch facility at the Pacific Spaceport Complex in Kodiak, Alaska, incorporating Norwegian launch sites could build space collaborative capacity into an overall allied launch network.³⁰³

c. Arctic Awareness

The 1970s witnessed Norwegian satellite surveillance and remote-sensing investment and collaboration with European and North American partners. Norway partnered with the United States on the Landsat 1 and 2 experiments and upgraded the

²⁹⁹ “Orbital Launch,” Andøya Space, accessed May 4, 2021, <https://www.andoyaspace.no/what-we-do/orbital-launch>.

³⁰⁰ OECD Library, “Norway.”

³⁰¹ OECD Library, “Norway.”

³⁰² “Norway Takes the Lead in Hybrid Propulsion,” The European Space Agency, last modified September 27, 2018, http://www.esa.int/Enabling_Support/Space_Transportation/Norway_takes_the_lead_in_hybrid_propulsion.

³⁰³ George Chambers, “Kodiak Island Spaceport Reopens Following 2014 Launch Failure,” NASA Spaceflight.com, last modified August 25, 2016, <https://www.nasaspaceflight.com/2016/08/kodiak-spaceport-reopens-2014-failure/>.

facilities of the Tromsø Telemetry Station to facilitate imaging download.³⁰⁴ These newly funded and promoted space solutions benefited the Norwegian industry and the military services. Additionally, the significant expansion of territorial waters in the late 1970s from the recognized 200-mile economic zone at sea created a national capability required to provide monitoring and surveillance of vast natural resources, including fishing, oil, and gas. According to Norwegian space records, this was best achieved through space-based solutions, especially synthetic aperture radar (SAR).³⁰⁵ ESA historical reports emphasized that “for the first time, space activity was linked to important overall government policy considerations.”³⁰⁶ These space-based solutions addressed the need for “surveillance of Norway’s territorial waters, and of the oil and fishing activity off the Norwegian coast.”³⁰⁷ Although Norway has historically been a consumer of space-based earth observation assets while primarily engaged in telemetry, tracking, and command (TT&C) activities of polar satellites, recent technological advancements in small satellite development have provided an avenue for national programs. These programs offer another opportunity for bilateral cooperation between the United States and Norway to address regional challenges of mutual interests.

As a nation with substantial maritime activities in fishing, oil and gas, and shipping, Norway has a defense and civil obligation to support maritime awareness and contribute to navigation solutions within the Arctic. The 2013 Norwegian national space policy highlighted that “the launch of AISSat-1 in 2010 showed that the Norwegian authorities, with modest effort, are able to finance and operate highly effective space infrastructure at the national level.”³⁰⁸ As of May 2021, Norway now has five maritime monitoring satellites in orbit with AISSat-1 and AISSat-2 along with NorSats 1, 2, and 3. According

³⁰⁴ Røberg and Collett, *HSR-35 Norwegian Space Activities 1958–2003: A Historical Overview*, 31–32.

³⁰⁵ Røberg and Collett, 34.

³⁰⁶ Røberg and Collett, 34.

³⁰⁷ Røberg and Collett, 33.

³⁰⁸ Norwegian Ministry of Trade and Industry, *Between Heaven and Earth: Norwegian Space Policy for Business and Public Benefit*, 10.

to NOSA, the AISSat series of small satellites “monitor maritime traffic in Norwegian and international waters by detecting AIS (Automatic Identification Signals) from ships to determine their position, speed and direction.”³⁰⁹ Although they were intended as demonstration and research satellites, the AISSat series proved so successful that they continue to provide daily monitoring of maritime traffic within the Arctic region.³¹⁰

Additionally, the NorSat 1 and 2 series of satellites that launched in July 2017 are slightly larger satellites but still classified as microsatellites.³¹¹ According to NOSA, NorSat 1 and 2 successfully achieved two-way communication through the VHS Data Exchange System (VDES), which provided the capability to send “data such as sea ice maps and emergency messages over the AIS system.”³¹² The newest NorSat 3 was launched in April 2021. According to a press release from Space Flight Laboratory which built the satellite, the NorSat-3 carries two payloads with one being the AIS receiver and the other “equipped with an experimental navigation radar detector developed by the Norwegian Defence Research Establishment (FFI) to augment the AIS receiver.”³¹³ Combining both receivers should provide improved maritime awareness data. These advancements in maritime domain awareness and navigation within the Arctic have the potential to contribute to a common allied operational picture within the Arctic maritime domain.

A recent Norwegian Defence Research Establishment (FFI)³¹⁴ report from 2020 emphasized the need for Norway to develop space-based surveillance assets and

³⁰⁹ “Norway’s Satellites,” Norwegian Space Agency, accessed May 13, 2021, <https://www.romsenter.no/eng/Norway-in-Space/Norway-s-Satellites>.

³¹⁰ Norwegian Space Agency, “Norway’s Satellites.”

³¹¹ Norwegian Space Agency, “Norway’s Satellites.”

³¹² Norwegian Space Agency, “Norway’s Satellites.”

³¹³ Space Flight Laboratory, “Norwegian Space Agency Announces Launch of NorSat-3 Maritime Tracking Microsatellite Built by Space Flight Laboratory (SFL),” SpaceRef, last modified April 29, 2021, <http://spaceref.com/news/viewpr.html?pid=57361>.

³¹⁴ The Norwegian Defence Research Establishment (FFI) is the prime research and development institution within the Norwegian Ministry of Defence.

autonomous long-range drones to improve its situational awareness over key areas of interest. The report stated, “For a small country like Norway with large marine areas to monitor, the development of low-orbit satellites and autonomous sensor-equipped drones with a long-range and endurance are of particular interest.”³¹⁵ As Norway’s armed forces attempt to increase their technological capabilities and capacity within these key areas, the United States can play a role in stimulating technological growth through collaboration and cooperation of mutual areas of interest. A technologically advanced Norwegian military with a comprehensive multi-domain surveillance architecture reinforces NATO’s northern flank and provides a critical capability within the region. The advancements at the Andøya Space Center and Norwegian small satellites on orbit contribute to reducing this gap, but further partnership in high resolution imagery over key maritime areas of interests is still needed.

d. Space Situational Awareness

Norwegian space activities have contributed to the space surveillance mission since the 1950s.³¹⁶ Due to Norway’s geographical advantage near the polar region, Norway is well suited for the space surveillance mission, as it can cover both geosynchronous and polar orbits. Today, Norway is a participating member of ESA’s SSA Programme and maintains close ties to the United States and the international community through its Globus space surveillance and radar facility in Vardø, Norway, and through its participation in the European Incoherent Scatter Scientific Association (EISCAT) radar systems located in Tromsø and Svalbard, Norway.³¹⁷ Like most of Norway’s space

³¹⁵ Norwegian Defence Research Establishment (FFI), *Technological Trends and Their Impact on Defence Planning*, FFI-Rapport 20/00228 (Kjeller, Norway: Norwegian Defence Research Establishment (FFI), 2020), 10, <https://publications.ffi.no/nb/item/asset/dspace:6626/20-00228.pdf>.

³¹⁶ Tim O’Connor, “Russia will ‘Take Measures’ Against U.S. Radar Near its Border, Thought to Be Part of Missile Defense,” *Newsweek World*, last modified May 23, 2019, <https://www.newsweek.com/russia-us-radar-norway-defense-1434756>.

³¹⁷ Brian Weeden, Paul Cefola, and Jaganath Sankaran, “Global Space Situational Awareness Sensors,” in *Advanced Maui Optical and Space Surveillance Technologies Conference*, 2010, 6, <https://swfound.org/media/15274/global%20ssa%20sensors-amos-2010.pdf>.

activities, Norwegian space surveillance initiatives are not funded solely through national means, but are supported through bilateral or multilateral space collaboration.

In 2017, the Norwegian Ministry of Defence and Norwegian Ministry of Trade, Industry, and Fisheries (NOSA is a government agency under this ministry) signed a data-sharing agreement with USSTRATCOM (agreement now resides under USSPACECOM) to share SSA data and services.³¹⁸ At the time, Maj. Gen. Odd-Harald Hagen, Head of the Department of Defence Policy and Long-Term Planning from the Norwegian Ministry of Defence, stated, “This situational space awareness memorandum of understanding is an important milestone for Norway’s development as an active and responsible space nation in the High North and Arctic.”³¹⁹ Furthermore, the data-sharing agreement highlights the continued cooperation with the United States in space surveillance activities that began in the 1950s and continues to grow due to the increasing importance of space domain awareness.

The Globus II facility is run by the Norwegian Intelligence Service (NIS) in cooperation with the United States. Established in 1997, the GLOBUS II space surveillance and radar facility is responsible for monitoring, tracking, and cataloguing objects out to geosynchronous orbit as well as strengthening “the ability of the Norwegian Defence Intelligence service to monitor the Norwegian area of military interest.”³²⁰ According to the U.S. Air Force, GLOBUS II is “a radar system located at Vardø, Norway, that is operated solely by Norwegian personnel, but which was developed by the United States and serves as part of the 29-sensor, global space surveillance network [SSN] that provides

³¹⁸ U.S. Strategic Command, “U.S. Strategic Command, Norway Sign Agreement to Share Space Services, Data,” USSTRATCOM Public Affairs, last modified April 5, 2017, <https://www.stratcom.mil/Media/News/News-Article-View/Article/1142970/us-strategic-command-norway-sign-agreement-to-share-space-services-data/>.

³¹⁹ U.S. Strategic Command, “U.S. Strategic Command, Norway Sign Agreement to Share Space Services, Data.”

³²⁰ Eldbjørg Løwer, Norwegian Minister of Defence, “The Globus II Radar and Norwegian Surveillance Activities in the North,” statement for clarification, February 25, 2000, <https://fas.org/spp/military/program/track/0000225-hs1.htm>.

data to the [USSPACECOM].”³²¹ Furthermore, Norwegian Ministry of Defence officials confirmed,

The radar is the only one of its kind in the world. It is an X-band (10 GHz), high resolution, single narrow beam, 200 Kw peak radiated power radar. It has a mechanically steered, parabolic reflector antenna of center-feed type, 27 meters in diameter and housed in a 35-meter diameter radome. [It] is mounted on a rotating pedestal and can track objects to geosynchronous altitude, about 41 000 kilometers.³²²

These specifications make the Globus II radar facility one of the most exquisite in the world. However, the radar site has come under intense scrutiny within Europe and Russia for its potential military applications as well as its close proximity to the Russian border as it is less than 40 miles from Russia’s Kola Peninsula.³²³ Open-source intelligence analysts report that Russian claims “that the GLOBUS II radar is also capable of providing key telemetry for the U.S. ballistic missile defense (BMD) program, including targeting data for Aegis-capable destroyers.”³²⁴ Consequently, the Russians clearly see the GLOBUS II radar system as a threat. In February 2018, the Director of NIS reported that “eleven Russian Su-24 tactical bombers conducted a simulated air attack on a GLOBUS II radar station.”³²⁵ Although these simulated bombing attacks by Russia indicate clear intent that the Globus radar site is a military target, the Norwegian Ministry of Defence “stressed that the radar is not to be part of any eventual U.S. missile defence...and the agreement between Norway and the United States specifies totally different tasks for the radar.”³²⁶

³²¹ Department of the Air Force, “Wright-Patterson Photo Gallery: GLOBUS II Picture” VIRIN: 080603-F-1025B-011.JPG, accessed May 12, 2021, <https://www.wpafb.af.mil/News/Photos/igphoto/2000611433/>.

³²² Løwer, “The Globus II Radar and Norwegian Surveillance Activities in the North.”

³²³ O’Connor, “Russia will ‘Take Measures’ Against U.S. Radar Near its Border, Thought to Be Part of Missile Defense.”

³²⁴ HARM and Gecko, “Cold War 2.0, Euro-Atlantic: Russia Simulates Air Attack on Norwegian Radar,” last modified February 13, 2019, <https://t-intell.com/2019/02/13/russia-simulates-air-attack-on-norwegian-radar/>.

³²⁵ HARM and Gecko, “Cold War 2.0, Euro-Atlantic: Russia Simulates Air Attack on Norwegian Radar.”

³²⁶ Løwer, “The Globus II Radar and Norwegian Surveillance Activities in the North.”

Moreover an FFI report from 2020, emphasized that “the Armed Forces currently have no sensors capable of detecting incoming ballistic missiles and no missiles capable of intercepting ballistic missiles.”³²⁷

Additionally, Norway contributes to the EISCAT Scientific Association, which is “an international organization funded and operated by research councils from Norway, Sweden, Finland, Japan, China and the UK.”³²⁸ Established in 1975, EISCAT operates four of the ten incoherent scatter radars in the world.³²⁹ The EISCAT Scientific Association is responsible for ionospheric and lower, middle, and upper atmospheric measurements for research in space weather, space debris, and the aurora borealis.³³⁰ Norway contributes two of the four sites located north of the Arctic circle, with sites in Tromsø, Norway and in Longyearbyen, Svalbard.³³¹ These sites partner through EISCAT with ESA’s SSA Programme to contribute to not only scientific space research but also to building SSA collaborative capacity within Europe.³³² As the United States also shares a SSA data-sharing agreement with ESA,³³³ the EISCAT program is another avenue for bilateral and regional cooperation to build space collaborative capacity within the Arctic. Furthermore, the Norwegian Ministry of Defence’s long-term defense strategy, with a focus on “high-tech and forward-looking defense,” highlighted that “the Government will establish a common space situation picture at the national level with military, civilian and commercial actors. In this context, the Armed Forces shall contribute to the development

³²⁷ Norwegian Defence Research Establishment (FFI), *Technological Trends and Their Impact on Defence Planning*, FFI-Rapport 20/00228 (Kjeller, Norway: Norwegian Defence Research Establishment (FFI), 2020), 10, <https://publications.ffi.no/nb/item/asset/dspace:6626/20-00228.pdf>.

³²⁸ Lal, Balakrishnan, Caldwell, Buenconsejo, and Carioscia, “Global Trends in Space Situational Awareness (SSA) and Space Traffic Management (STM),” 33.

³²⁹ Emma Unander, “Welcome to EISCAT Scientific Association,” EISCAT Scientific Association, last modified February 15, 2021, <https://eiscat.se/about/>.

³³⁰ Unander, “Welcome to EISCAT Scientific Association.”

³³¹ Unander, “Welcome to EISCAT Scientific Association.”

³³² The European Space Agency, “SSA Programme Overview.”

³³³ Mike Gruss, “U.S. Strategic Command, ESA Sign Space Surveillance Data-Sharing Agreement,” SpaceNews, last modified October 31, 2014, <https://spacenews.com/42384us-strategic-command-esa-sign-space-surveillance-data-sharing-agreement/>.

and establishment of national capacity for the SSA.”³³⁴ Based on the evidence within this section, it is clear that the United States and Norway have extensive bilateral cooperation within the space surveillance mission, which provides an avenue for further cooperation in additional space collaboration initiatives.

e. Space Ground Infrastructure

In 1965, the NTNF, in collaboration with ESRO, established a critical piece of space ground infrastructure with the establishment and operation of a satellite station on Svalbard at Spitsbergen.³³⁵ Additionally, in 1966 the NDRE, in collaboration with the United States and Canada, established the Tromsø telemetry station to support the International Satellite for Ionospheric Studies (ISIS) program.³³⁶ ESA historical records state, “Development of the satellite stations in Ny-Ålesund [Spitsbergen] and Tromsø considerably enlarged the scope of Norwegian space-related scientific activity, as did the expansion of scientific work at the Auroral Observatory in Tromsø.”³³⁷ Although both sites supported scientific research, both were also considered dual-use for military purposes. Historical records confirm that “The Soviets alleged that the ESRO station was, in fact, a camouflaged espionage centre, with the aim of serving NATO surveillance satellites and possibly also military air traffic.”³³⁸ These political barriers continue today, with Norwegian telemetry stations often receiving adverse reactions from Russian leaders due to their dual-use nature and proximity. However, the establishment of both sites further exemplified Norway’s ability to leverage space cooperative agreements between North American and European partners. These initial programs established the foundation for the advanced space ground infrastructure at both sites today.

³³⁴ Norwegian Ministry of Defence, *Notify. St. 17 (2020-2021): Cooperation for Security – National Defense Industrial Strategy for a High-Tech and Forward-Looking Defense* (Oslo, NO: Ministry of Defence, 2021), <https://www.regjeringen.no/no/dokumenter/meld.-st.-17-20202021/id2838138/>.

³³⁵ Røberg and Collett, *HSR-35 Norwegian Space Activities 1958–2003: A Historical Overview*, 14.

³³⁶ Røberg and Collett, 16–17.

³³⁷ Røberg and Collett, 18.

³³⁸ Røberg and Collett, 14.

Norway's proximity to the polar region provides it a geographical advantage for making observations of the polar region as well as transmitting and receiving satellite data from satellites in polar orbits. According to the 2019 Norwegian space strategy, "Norway has multiple satellite ground stations, including in Svalbard, on Jan Mayen Island and in Dronning Maud Land."³³⁹ Although Dronning Maud Land is in Antarctica and not the Arctic, Norway enjoys the distinction and significant astrostrategic advantage of possessing satellite ground stations at both poles of the Earth.³⁴⁰ However, an ESA report emphasizes the astrostrategic significance of Svalbard in particular, stating, "even more ideal is the position of Svalbard, halfway between the Norwegian mainland and the North Pole, and blessed with the most favourable (sic) climate of all sites on the same latitude."³⁴¹ Admiral James Stavridis, former NATO Supreme Allied Commander Europe, further highlighted the strategic importance of Svalbard stating, "The Norwegian island of Svalbard, high up in the Arctic Ocean, dominates the Barents Sea and constitutes a significant thorn in the side of Russian ambitions in the region."³⁴²

The Svalbard satellite (SvalSat) station on Svalbard possesses the largest ground station in the world for monitoring polar orbits.³⁴³ ESA records highlight that the SvalSat station "is an important part of the ground infrastructure for NASA and EUMETSAT, in addition to ESA Earth observation missions and for the Galileo and Copernicus satellites

³³⁹ Norwegian Space Agency, *The Government's Strategy for Norwegian Space Activities* (Oslo, NO: Norwegian Space Agency, 2019), 5, <https://www.regjeringen.no/no/dokumenter/meld.-st.-10-20192020/id2682361/>.

³⁴⁰ According to the Norwegian Polar Institute, Dronning Maud Land was annexed by Norway on January 14, 1939. Norway is one of seven nations with claims in Antarctica including Argentina, Australia, Chile, France, New Zealand, Norway, and the United Kingdom.

³⁴¹ Røberg and Collett, *HSR-35 Norwegian Space Activities 1958–2003: A Historical Overview*, 59.

³⁴² Stavridis, *Sea Power: The History and Geopolitics of the World's Oceans*, 253.

³⁴³ Norwegian Ministry of Trade and Industry, *Between Heaven and Earth: Norwegian Space Policy for Business and Public Benefit*, 67.

being launched by ESA in agreement with the European Commission.”³⁴⁴ As the largest commercial ground station for distributing TT&C data to and from polar satellites, the SvalSat station is of critical importance to both United States and European space initiatives. The SvalSat ground station receives updates from every polar orbiting satellite, with 14 passes over the ground station each day.³⁴⁵ However, a recent security review from the Heritage Foundation in 2020 emphasizes the space security concerns related to Svalbard, stating, “the geostrategic location of Svalbard, especially in terms of its proximity to the Kola Peninsula, home of Russia’s Northern Fleet, is not lost on the Russians.”³⁴⁶ Svalbard’s geopolitical situation is unique within the Arctic due to the Spitsbergen Treaty from 1920, which prevents a permanent Norwegian military presence on the island.³⁴⁷ This creates a challenging security dilemma for Norway and the United States, as essential space ground infrastructure is left undefended.

B. KINGDOM OF DENMARK

The Kingdom of Denmark inclusive of Denmark, Greenland, and the Faroe Islands is centrally located in the Arctic due to its vast land areas in Greenland northeast of the North American continent. Similar to Norway within the previous section, the Kingdom of Denmark is also a founding member of NATO and a strategic national security ally of the United States with a shared commitment to Arctic security. The Kingdom of Denmark is analyzed as a comparative case study instead of Canada, Finland, Iceland, or Sweden due to its comparable cooperation in space activities to Norway as well as its significant history of national space security cooperation with the United States. Unlike Canada, which also

³⁴⁴ “Managing Signals at the Top of the World,” The European Space Agency, accessed April 10, 2021, http://www.esa.int/Enabling_Support/Preparing_for_the_Future/Space_for_Earth/Arctic/Managing_signals_at_the_top_of_the_world.

³⁴⁵ Tony Dunnell, “Svalbard Satellite Station: Svalbard and Jan Mayen,” accessed April 13, 2021, <https://www.atlasobscura.com/places/svalbard-satellite-station>.

³⁴⁶ Luke Coffey, “Russia’s and China’s Interest in Cold Svalbard Heats Up,” The Heritage Foundation, last modified February 17, 2020, <https://www.heritage.org/defense/commentary/russias-and-chinas-interest-cold-svalbard-heats>.

³⁴⁷ Sissel Finstad, “The Svalbard Treaty,” Svalbard Museum, accessed April 19, 2021, <https://svalbardmuseum.no/en/kultur-og-historie/svalbardtraktaten/>.

has a significant history in national security space cooperation with the United States, Norway and Denmark's space activities are on a much smaller financial scale. However, as highlighted by Gleason and Weeden and demonstrated by the research within the chapter, "smaller countries, with fewer capabilities and resources, still make significant contributions to a coalition by bolstering deterrence, supplying information, providing geographic advantage, and enhancing the international legitimacy of U.S. actions."³⁴⁸ This section analyzes Danish space activities to provide a comparative case study on how Norwegian and Danish space activities can contribute to a U.S. cooperative space strategy in the Arctic.

1. Brief History of Denmark's Space Activity

Denmark has been involved in space activities since the late 19th century, with its scientific research on the Earth's magnetic field, the ionosphere, and the aurora borealis due to its geographic location in northern Europe.³⁴⁹ The post-World War II era witnessed Danish participation in European space collaboration initiatives, with extensive bilateral and regional Scandinavian cooperation with Norway and Sweden at their respective launch sites at Andøya and Kiruna, and the scientific community at the Danish Ionosphere Laboratory at the Technical University of Denmark (DTU).³⁵⁰ As a founding member of the NATO alliance in 1949, the Kingdom of Denmark and the United States have a long history of security cooperation in space activities that will be discussed in greater detail in the following sections.³⁵¹ This relationship has seen Denmark's space activities largely separated between its industrial and scientific space activities through its European partners within the EU and ESA, and its defense space activities through its NATO and bilateral agreements with the United States.

³⁴⁸ Gleason and Weeden, "Alliance Rationales & Roadblocks: A U.S. – Canada Space Study," 4.

³⁴⁹ Preben Gudmandsen, *HSR-33 ESRO/ESA and Denmark* (The Netherlands: The European Space Agency, 2003), 3, https://www.esa.int/esapub/hsr/HSR_33.pdf.

³⁵⁰ Gudmandsen, *HSR-33 ESRO/ESA and Denmark*, 3.

³⁵¹ "Member Countries," North Atlantic Treaty Organization, accessed May 24, 2021, <https://www.nato.int/nato-welcome/index.html>.

Denmark's European space activities formally began in 1964 with its participation in regional space collaborative initiatives when it joined the ESRO; it eventually became a founding member of ESA in 1975.³⁵² As a founding member, Denmark has contributed to numerous scientific and economic European space initiatives since joining the international organization.³⁵³ The Danish Space Research Institute (DSRI) was established in 1966. Since then, almost all Danish space research was conducted by or in coordination with DSRI through the early 2000s.³⁵⁴ Early research predominantly included Earth Observation through the monitoring of sea and land ice in the Arctic, the design of sounding rocket payloads, and development and manufacturing of instruments and measurement systems for satellites.³⁵⁵ European space policy experts have described Denmark's contributions to space collaborative initiatives as having an outsized impact. The chairman of the DSRI in an interview in 1979 stated, "the Danish contribution to ESA space programme is about 2% but it is not exaggerated when we claim that our part of the European space experiments is almost three times as valuable."³⁵⁶ This claim extends into today as the Space Generation Advisory Council emphasized, "compared to its size, Denmark has a strong presence among the space faring nations...from design and delivery of spacecraft components through universities and private companies, to the first Danish astronaut Andreas Mogensen, who flew on the International Space Station in 2015."³⁵⁷

In 2007, the National Space Institute (NSI) at DTU, known as DTU Space, was formed through the merger of the Danish National Space Center (DNSC) and various research groups within Denmark, to include DSRI, the Danish Meteorological Institute,

³⁵² Gudmandsen, *HSR-33 ESRO/ESA and Denmark*, 6.

³⁵³ "History of Europe in Space," The European Space Agency, accessed May 24, 2021, http://www.esa.int/About_Us/ESA_history/History_of_Europe_in_space.

³⁵⁴ Gudmandsen, *HSR-33 ESRO/ESA and Denmark*, 20.

³⁵⁵ Gudmandsen, 20.

³⁵⁶ Gudmandsen, 21.

³⁵⁷ "SGAC Denmark," Space Generation Advisory Council, accessed May 24, 2021, <https://spacegeneration.org/regions/europe/denmark>.

and the Defence Research Establishment.³⁵⁸ Relatively recent Danish space accomplishments include the first Danish research satellite Ørsted in 1999, development of star trackers for NASA's Juno mission, manufacturing components and sensors for ESA's ASIM-mission in 2018, and designing cameras for NASA's Mars rover mission in 2020.³⁵⁹ Denmark collaboratively published its first national space strategy in 2016 between its various governmental ministries, to include its Ministry of Defence and Ministry of Higher Education and Science.³⁶⁰ According to the 2016 Danish National Space Strategy, "Danish businesses are typically strong in various niche areas such as power control technologies, nanosatellites, software simulation systems, use of Earth observation data, electronic components, star trackers and terminals for receiving satellite signals."³⁶¹ Denmark's estimated space budget for ESA activities and programs in 2021 is approximately 40 million dollars accounting for 0.7 percent of ESA budget.³⁶² As of May 2021, it is unknown the current Danish national space budget, but historical records indicate ESA activities account for approximately 90 percent of the total Danish space budget.³⁶³

2. Motivations and Key Trends

As a self-described "major Arctic power," the Kingdom of Denmark inclusive of Denmark, Greenland, and the Faroe Islands has a significant role in Arctic affairs due to

³⁵⁸ Morten Garly Andersen, "History," DTU Space: National Space Institute, last modified February 27, 2021, https://www.space.dtu.dk/english/about_nsi/history.

³⁵⁹ Andersen, "History," DTU Space: National Space Institute.

³⁶⁰ Danish Ministry of Higher Education and Science, *Denmark's National Space Strategy: Growth Through Strengthened Cooperation* (Copenhagen, DK: The Government, 2016), 7, <https://ufm.dk/en/publications/2016/files/space-strategy-2016.pdf>.

³⁶¹ Danish Ministry of Higher Education and Science, *Denmark's National Space Strategy: Growth Through Strengthened Cooperation*, 25.

³⁶² "Funding," The European Space Agency, accessed May 24, 2021, http://www.esa.int/About_Us/Corporate_news/Funding.

³⁶³ Brian Harvey, *Europe's Space Programme: To Ariane and Beyond* (Chichester, UK: Praxis Publishing, 2003), 149.

Greenland and the Faroe Islands' geostrategic locations within the Arctic region.³⁶⁴ Greenland is the world's largest island and lies along the transpolar route between the polar great powers of the United States and Russia. Similarly, the Faroe Islands are located along a strategic maritime corridor between Iceland and the United Kingdom (UK). Magnus Nordenman, an expert on NATO and security in Northern Europe, emphasized the Kingdom of Denmark's geostrategic importance to NATO and U.S. security in the Arctic stating, "Denmark is a founding member of NATO and played a vital role on NATO's northern flank during the Cold War due to its geographical location."³⁶⁵

The reemerging Russian security threat is refocusing allied and partner efforts within the Arctic, and Denmark is responding accordingly. Although Denmark seeks to avoid the militarization of the Arctic and promote international cooperation within the region, its recent Arctic strategy highlights its responsibility to exercise sovereignty and surveillance of the region. The strategy states, "While the Kingdom's area in the Arctic is covered by the NATO treaty Article 5 regarding collective defence, the enforcement of sovereignty is fundamentally a responsibility of the Realm's central authorities. Enforcement of sovereignty is exercised by the armed forces through a visible presence in the region where surveillance is central to the task."³⁶⁶

However, the 2016 Danish space strategy highlighted current Danish challenges within the Arctic, stating, "the Arctic is one such area in which a lack of satellite coverage makes it difficult for the defence forces to perform their duties."³⁶⁷ The strategy

³⁶⁴ Peter Taksøe-Jensen, "Executive Summary: Danish Diplomacy and Defence in Times of Change: A review of Denmark's Foreign and Security Policy" (Copenhagen, DK: Ministry of Foreign Affairs of Denmark, 2016), 5, <https://um.dk/en/foreign-policy/danish-defence-and-diplomacy-in-times-of-change/>.

³⁶⁵ Magnus Nordenman, "The US-Danish Defense and Security Relationship: Keeping Up in a Changing World," Atlantic Council: Snowcroft Center for Strategy and Security, last modified February 12, 2019, 2, <https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/the-us-danish-defense-and-security-relationship-2/>.

³⁶⁶ Ministry of Foreign Affairs of Denmark, *Denmark, Greenland and the Faroe Islands: Kingdom of Denmark Strategy for the Arctic 2011–2020* (Copenhagen, DK: Ministry of Foreign Affairs, 2011), 20, <https://um.dk/en/foreign-policy/the-arctic/>.

³⁶⁷ Danish Ministry of Higher Education and Science, *Denmark's National Space Strategy: Growth Through Strengthened Cooperation*, 16.

emphasizes the need for Denmark to engage in space collaborative initiatives with partners to address these challenges stating, “there is potential for increased cooperation with other Arctic nations such as Canada, the U.S. and Norway.”³⁶⁸ The strategy concludes that future Danish space priorities within the Arctic should, “investigate the possibilities for a public-private partnership to develop a satellite-based solution for communication in the Arctic...[and] strengthen coordination between emergency services and defence forces to ensure rapid and efficient data sharing in the form of a cooperation agreement.”³⁶⁹ Denmark also plans to leverage its extensive participation in both the Galileo and Copernicus programs to expand its capability in navigation and remote-sensing services within the Arctic region.

Additionally, a Danish security review from 2016 concluded, “Denmark should explore possible satellite-based solutions to strengthen communication and surveillance in the Arctic...In light of the increased military presence and activity level in the Arctic, it should be explored whether there is support for a discussion forum on security policy related to the Arctic.”³⁷⁰ Nordenman’s recommendations align with this sentiment when he concludes, “Washington and Copenhagen should continue to explore appropriate roles for Denmark, in concert with the UK, Norway, Iceland, and Canada in the emerging new Alliance posture in the North Atlantic.”³⁷¹ Although this recommendation does not align with a cooperative space strategy specific to the Arctic states proposed within this thesis, it does provide evidence to the sentiment and need for a cooperative space strategy specific to the region.

Furthermore, the security review highlights Denmark’s unique position to promote regional and international cooperation, stating, “Denmark’s membership to the EU, NATO and the UN thus constitutes the foundation for promoting Danish interests

³⁶⁸ Danish Ministry of Higher Education and Science, 18.

³⁶⁹ Danish Ministry of Higher Education and Science, 17, 19.

³⁷⁰ Taksøe-Jensen, “Executive Summary: Danish Diplomacy and Defence in Times of Change: A Review of Denmark’s Foreign and Security Policy,” 9.

³⁷¹ Nordenman, “The US-Danish Defense and Security Relationship: Keeping Up in a Changing World,” 7.

internationally.”³⁷² It goes on to state, “Denmark has major advantages of binding international cooperation and rules which ensure a level playing field, influence of smaller countries and promote multilateral solutions. International challenges require international solutions.”³⁷³ In May 2021, Secretary of State, Antony Blinken emphasized Denmark’s strategic importance in building regional collaboration amongst not only the Arctic states, but globally due its memberships in key institutions, stating, “As the only country that belongs to NATO, the European Union, and the Arctic Council, Denmark consistently plays a leadership role in regional and global affairs.”³⁷⁴ This sentiment reinforces Danish space collaborative capacity to engage with allies and partners within the region and highlights Danish tendency to engage in multilateralism to address shared challenges.

Although Danish space activities have been almost entirely focused on scientific accomplishments and industrial support to space component manufacturing, recent advances in space technology have seen Danish space activities shift to national solutions to address emerging Arctic-related challenges. The 2016 Danish National Space Strategy emphasizes, “due to the rapid pace of technological change the exploitation of space is now possible by means of small satellites, which allows even small countries like Denmark to participate.”³⁷⁵ The strategy goes on to highlight, “The Ministry of Defence’s requirement for surveillance data is being met by a large number of suppliers, non-military as well as military, through cooperation agreements and through procurement of data for use in vessel traffic monitoring.”³⁷⁶ This mix of public-private partnerships, international collaboration, and bilateral partnerships with the United States and other NATO allies could likely contribute to addressing U.S. strategic capability gaps within the region.

³⁷² Taksøe-Jensen, “Executive Summary: Danish Diplomacy and Defence in Times of Change: A Review of Denmark’s Foreign and Security Policy,” 5.

³⁷³ Taksøe-Jensen, 7.

³⁷⁴ Department of State, “Secretary Antony J. Blinken and Danish Foreign Minister Jeppe Kofod at a Joint Press Availability.”

³⁷⁵ Danish Ministry of Higher Education and Science, *Denmark’s National Space Strategy: Growth Through Strengthened Cooperation*, 6.

³⁷⁶ Danish Ministry of Higher Education and Science, 19.

3. Areas of Cooperation

Denmark and the United States have cooperated in space activities since the beginning of the space age. As a founding member of NATO and a key U.S. security partner with significant global relationships, Denmark's emerging capability in the space sector could prove consequential for future space collaboration within the Arctic. The following mission areas can be identified as areas of cooperation between the United States and the Kingdom of Denmark.

a. *Arctic Awareness*

Due to the changing geostrategic environment and the emerging challenges within the region, the Danish Defence Agreement 2010–2014 recognized the need for a more robust Danish Armed Forces presence within the Arctic. In an effort to streamline and establish unity of command amongst its various territorial aligned commands, the Defence Agreement concluded, “the Greenland Command and the Faroe Command are to be combined into a joint service Arctic Command.”³⁷⁷ Recently established in October 2012, and headquartered in Nuuk, Greenland, the mission of Denmark's Joint Arctic Command (JACO) is “to protect the sovereignty of the Kingdom of Denmark in the Arctic Region.”³⁷⁸ As a joint operational territorial command, JACO's main tasks are to provide for the defense and maintain all-domain awareness of Danish sovereign territory in Greenland and the Faroe Islands.³⁷⁹ Due to the geographic location and enormous size of the island of Greenland within the Arctic region and the geostrategic location of the Faroe Islands along the strategic maritime corridor, JACO includes geostrategic areas of importance for not only Denmark, but the United States and the NATO alliance.

These strategic relationships have seen recent strategic engagement between JACO and both the United States and NATO. In September 2020, the United States and NATO

³⁷⁷ Danish Ministry of Defence, *Danish Defence Agreement 2010–2014* (Copenhagen, DK: Ministry of Defence, 2009), 12, <https://www.files.ethz.ch/isn/154939/Denmark2010-2014English.pdf>.

³⁷⁸ “Joint Arctic Command,” The Danish Armed Forces, last modified March 4, 2021, <https://forsvaret.dk/en/organisation/joint-arctic-command/about-us/>.

³⁷⁹ The Danish Armed Force, “Joint Arctic Command.”

reestablished NATO's Atlantic Command in Norfolk, Virginia, with the mission to maintain situational awareness and conduct operations in the North Atlantic and the Arctic.³⁸⁰ Additionally, in October 2020, a statement from NATO read, "as part of strengthening its Arctic cooperation, NATO's Maritime Command (MARCOM) has established a new operational coordination arrangement with the Danish Joint Arctic Command (JACO) in Greenland."³⁸¹ Vice Admiral Keith Blount, Commander of MARCOM stated, "Over the past years we have seen an increasing maritime interest in the Arctic region. I anticipate that MARCOM and JACO will greatly benefit from working together on an operational level under this new agreement."³⁸² The NATO public affairs office further highlights, "the enhanced cooperation will include monthly coordination meetings, exchange of surveillance information, and participation in exercises, among other activities."³⁸³ This restructuring of NATO commands and Danish defense commands reinforces the already strong international relationships between Arctic allies and partners and should benefit situational awareness within the region going forward.

The Danish Defence Agreement 2010–2014 further directed what it called "an analysis of whether or not advantages exist in entering into closer cooperation with other Nordic countries, the USA, Canada, Russia and the UK regarding surveillance and other similar tasks."³⁸⁴ Although this proposed surveillance collaboration includes Russia as a potential partner, it should be noted that this strategy was published prior to the 2014 Russian invasion of Crimea, which significantly altered the geopolitical reality within the Arctic region. It also should be noted that Denmark's defense agreement divides tasks within the Arctic into national and international tasks. It identifies national tasks as search

³⁸⁰ "NATO's New Atlantic Command Declared Operational," North Atlantic Treaty Organization, last modified September 18, 2020, https://www.nato.int/cps/en/natohq/news_178031.htm.

³⁸¹ "NATO Begins Cooperation with Danish Joint Arctic Command in Greenland," North Atlantic Treaty Organization, last modified October 1, 2020, <https://mc.nato.int/media-centre/news/2020/nato-begins-cooperation-with-danish-joint-arctic-command-in-greenland>.

³⁸² NATO, "NATO Begins Cooperation with Danish Joint Arctic Command in Greenland."

³⁸³ NATO, "NATO Begins Cooperation with Danish Joint Arctic Command in Greenland."

³⁸⁴ Danish Ministry of Defence, *Danish Defence Agreement 2010–2014*, 12.

and rescue, environmental monitoring, and emergency services, which all still garner significant cooperation amongst the Arctic states regardless of external tensions.³⁸⁵ Additionally, this separation in focus of tasks within the region highlights the dual-use capability of space cooperative initiatives as space capabilities have the potential to address both areas of concern. An example of this is Russian cooperation in the search and rescue mission utilizing its Artika satellites that contribute to both surveillance and environmental monitoring mission areas within the Arctic.³⁸⁶

An analysis by Jacob Gronholt-Pedersen for Reuters highlighted the immense awareness challenges Denmark faces within the Arctic. He states, “Today, to monitor its vast area, Greenland has one aircraft, four helicopters and four ships. In addition to enforcing sovereignty, they handle fishing inspection and search and rescue operations. Six sleds powered by 80 dogs patrol the remote northeastern part.”³⁸⁷ This is compounded by the immense size of Greenland, which is the world’s largest non-continental island and over three times the size of Texas.³⁸⁸ The Arctic Council highlights that “Greenland’s icecap covers 81 percent of its area, leaving 15 percent of the coastline inhabitable...[and] the population density is the lowest in the world.”³⁸⁹ Gronholt-Pedersen goes on to emphasize that, “Denmark has no satellites to monitor traffic around Greenland. In 2018, it started receiving a few satellite images a day from the European Union’s Maritime Safety Agency, but they aren’t always detailed enough for military purposes.”³⁹⁰ This analysis is

³⁸⁵ Danish Ministry of Defence, 3.

³⁸⁶ “Russia Launches Satellite to Monitor Climate in Arctic,” Reuters, last modified February 28, 2021, <https://www.reuters.com/article/us-russia-arctic-satellite/russia-launches-satellite-to-monitor-climate-in-arctic-idUSKCN2AS0A7>.

³⁸⁷ Jacob Gronholt-Pedersen, “As the Arctic’s Attractions Mount, Greenland is a Security Black Hole,” Reuters, last modified October 19, 2020, <https://www.reuters.com/article/us-climate-change-greenland-security-ins/as-the-arctics-attractions-mount-greenland-is-a-security-black-hole-idUSKBN2750J6>.

³⁸⁸ Don Vaughan, “The Largest Islands in the World,” Britannica, accessed May 23, 2021, <https://www.britannica.com/list/the-largest-islands-in-the-world>.

³⁸⁹ Thomas Winkler, “The Kingdom of Denmark,” Arctic Council, accessed May 23, 2021, <https://arctic-council.org/en/about/states/denmark/>.

³⁹⁰ Gronholt-Pedersen, “As the Arctic’s Attractions Mount, Greenland is a Security Black Hole.”

confirmed by a Danish government-sponsored review of user's space activities, highlighting the Defence Command Denmark's (DCDA), "main task is surveillance and enforcement of sovereignty, which is undertaken with assistance from various radar satellites, including Radarsat2, Sentinel 1 & 2 and Tecsar."³⁹¹ Although these satellites have the capability to provide high spatial resolution imagery, the report highlights JACO's need for national solutions to improve access for real-time data and access to satellite and drone-generated data. The report proposes further Danish investment to establish a ground station in Greenland and a datahub that would increase the speed of access and prevent data gaps to provide real-time monitoring and intelligence collection.³⁹²

The government security review also highlights recent Danish advances to improve navigation, monitoring, and situational awareness within the Arctic. It highlights the Danish Maritime Authority's (DMA) recent success in leading a joint regional project funded by the Nordic Council of Ministers and currently run by Norway.³⁹³ ArcticWeb increases maritime domain awareness by collecting user generated data to improve navigation and safety within the Arctic.³⁹⁴ Additionally, since 2013, Danish industry and university collaboration initiatives have built multiple small satellites to improve space research opportunities and specifically address Arctic challenges.³⁹⁵ These initiatives have seen the launch of the Aalborg University satellites (AAUsat) and GOMX series of nanosatellites that leverage the AIS and automatic dependent surveillance-broadcast (ADS-B) receivers for tracking ships and aircraft in the Arctic.³⁹⁶ The Ulloriaq (GOMX-

³⁹¹ Ramboll, *Mapping of the Kingdom of Denmark's Users of Space Generated Information and Space Infrastructure in the Arctic* (Hannemanns, DK: The Ministry of Higher Education and Science, 2020), 19, <https://www.gransking.fo/media/3579/mapping-of-the-kingdom-of-denmarks-users-of-space-related-information-and-infrastructure.pdf>.

³⁹² Ramboll, *Mapping of the Kingdom of Denmark's Users of Space Generated Information and Space Infrastructure in the Arctic*, 65.

³⁹³ Ramboll, 20.

³⁹⁴ "Norway Is Now The Owner of ArcticWeb," Safety4Sea, last modified June 4, 2018, <https://safety4sea.com/norway-is-now-the-owner-of-arcticweb/>.

³⁹⁵ United Nations Office of Outer Space Affairs (UNOOSA), "Online Index of Objects Launched into Outer Space," accessed May 21, 2021, <https://www.unoosa.org/oosa/osoindex/>.

³⁹⁶ UNOOSA, "Online Index of Objects Launched into Outer Space."

4A) and GOMX-4B 6U satellites operate in tandem to demonstrate hyperspectral imaging, functionality of ADS-B and AIS receivers, and inter-satellite linking for coverage solutions over the Arctic.³⁹⁷ According to Danish commercial company GomSpace, the GOMX-4 satellites launched in 2018 are a space collaboration project to provide Arctic surveillance and demonstrate the viability of building nanosatellite constellations for European high-latitude applications. The GOMX-4 is a research and development mission between the Danish Defence Acquisition and Logistics Organization (DALO), DTU, and ESA. These recent space activities are evidence that an emerging space nation like Denmark, with a regional focus and limited budget, can provide niche capabilities and identify best practices to reinforce space collaborative initiatives to address shared surveillance and communications challenges within the region.

Additionally, in a 2020 interview with Reuters, Danish Defense Minister Trine Bramsen stated, “Denmark is taking steps towards strengthening the Armed Forces’ surveillance and presence [within the Arctic].”³⁹⁸ This statement follows a July 2020 meeting between then-U.S. Secretary of State Michael Pompeo and Denmark’s Foreign Minister Jeppe Kofod, where Denmark and the United States reaffirmed their commitment to building situational awareness through continued coordination and cooperation to address shared challenges within the region.³⁹⁹ These statements also coincide with the U.S. Air Force’s 2020 Arctic Strategy published in July 2020, which called for the U.S. Air Force and Space Force to “commit to enhancing its northernmost missile defense capabilities, exploring new surveillance and communications technologies and updating its dilapidated infrastructure in the region.”⁴⁰⁰

³⁹⁷ GomSpace, “Arctic Surveillance and the Building Blocks of Constellations,” GOMX-4 by GomSpace, accessed May 24, 2021, <https://gomspace.com/gomx-4.aspx>.

³⁹⁸ Gronholt-Pedersen, “As the Arctic’s Attractions Mount, Greenland is a Security Black Hole.”

³⁹⁹ Eilís Quinn, “Denmark, U.S. Affirm Need to ‘Maintain and Build Situational Awareness’ in the Arctic,” Eye on the Arctic, last modified July 24, 2020, <https://www.rcinet.ca/eye-on-the-arctic/2020/07/24/denmark-u-s-affirm-need-to-maintain-and-build-situational-awareness-in-the-arctic/>.

⁴⁰⁰ Valerie Insinna, “Armed with a New Arctic Strategy, the Air Force Seeks Increased Connectivity in the Region,” DefenseNews, last modified July 21, 2020, <https://www.defensenews.com/air/2020/07/21/armed-with-a-new-arctic-strategy-the-air-force-seeks-increased-connectivity-in-the-region/>.

Denmark has made recent strides to increase defense funding and address Arctic challenges. Nordenman highlights that the 2018 Danish defense agreement, “sets out policy priorities and funding levels for Danish defense between 2018 and 2023, [which] includes a 20 percent increase in Danish defense spending.”⁴⁰¹ Additionally, a recent political agreement to invest in Arctic capabilities from the governments of Denmark, Greenland, and the Faroe Islands, promised an estimated 240 million dollars to strengthen Danish Defence capabilities in the Arctic and the North Atlantic.⁴⁰² The agreement emphasized that the Kingdom of Denmark has a “special responsibility in regards to defence and security in the Arctic and the North Atlantic...The Danish Defence will be strengthened with new capabilities to monitor the increased activity in the region. A task which is best solved in close cooperation with the United States and Arctic Allies, founded on NATO and in respect of international agreements.”⁴⁰³ In a joint statement between Secretary of State Blinken and Danish Foreign Minister Kofod in May 2021, Blinken emphasized U.S. and Danish partnership within the Arctic, stating, “We share a commitment to Arctic security. We very much welcome Denmark’s recent decision to invest more than \$240 million in North Atlantic and Arctic defense in coordination with the governments of Greenland and the Faroe Islands.”⁴⁰⁴ This investment in space activities is evidence that Denmark understands the challenges ahead and is demonstrating a willingness to address space capability gaps specific to surveillance and domain awareness within the region.

⁴⁰¹ Nordenman, “The US-Danish Defense and Security Relationship: Keeping Up in a Changing World,” 5.

⁴⁰² Danish Ministry of Defence, *Agreement on Arctic Capabilities* (Copenhagen, DK: Ministry of Defence, 2021), 1, <https://fmn.dk/globalassets/fmn/dokumenter/nyheder/2021/-factsheet-agreement-on-arctic-capabilities-.pdf>.

⁴⁰³ Danish Ministry of Defence, *Agreement on Arctic Capabilities*, 1.

⁴⁰⁴ “Secretary Antony J. Blinken and Danish Foreign Minister Jeppe Kofod at a Joint Press Availability,” Remarks by Antony J. Blinken, Secretary of State at Eigtveds Pakhus in Copenhagen, Denmark on May 17, 2021, Department of State, accessed June 2, 2021, <https://www.state.gov/secretary-antony-j-blinken-and-danish-foreign-minister-jeppe-kofod-at-a-joint-press-availability/>.

b. Ballistic Missile Defense

The Kingdom of Denmark, via Greenland, hosts the ballistic missile early warning radar system at the joint Danish and American Thule Air Base. Initially established in 1943 as a weather and radio station to support allied operations in the North Atlantic during World War II, Thule Air Base in northwest Greenland is the United States' most northern installation.⁴⁰⁵ During the postwar years, the United States sought a long-term solution to maintain its strategic foothold in the Arctic region. U.S. Space Force historical documents highlight the geostrategic location of Thule, stating, "the shortest route from the U.S. to the Soviet Union's most important industrial areas was over the North Pole, and Thule is at the precise midpoint between Moscow and New York."⁴⁰⁶ Additionally, they point out the strategic partnership between the United States and Denmark in the Arctic relating to the early warning and missile defense mission. In 1951, Denmark and the United States signed an agreement "for the use of facilities in Greenland by NATO forces in defense of the NATO area known as the Greenland Defense Area."⁴⁰⁷ This agreement continues today.

In 1961, the United States installed a ballistic missile early warning system (BMEWS) radar at the joint Danish and American Thule Air Base, and later upgraded the system to a solid-state, phased-array system in 1987.⁴⁰⁸ Denmark approved the current Upgraded Early Warning Radar (UEWR) system in 2004, with its construction completed in 2008.⁴⁰⁹ Although further upgrades were made to the system in 2018, the system's mission remains to "provide detection and tracking of ballistic missiles and interceptors, and classification of space objects."⁴¹⁰ Complementary systems that contribute to the

⁴⁰⁵ U.S. Space Force, "Welcome to Thule, "The Top of the World,"" accessed May 24, 2021, 28, <https://download.militaryonesource.mil/12038/Plan%20My%20Move/Thule%20Information.pdf>.

⁴⁰⁶ U.S. Space Force, "Welcome to Thule, "The Top of the World,"" 28.

⁴⁰⁷ U.S. Space Force, 29.

⁴⁰⁸ U.S. Space Force, 30–31.

⁴⁰⁹ "Upgraded Early Warning Radars (UEWR): U.S. – Missile Defense, Sensor," Missile Defense Advocacy Alliance (MDAA), last modified December 2018, accessed May 24, 2021, <https://missiledefenseadvocacy.org/defense-systems/upgraded-early-warning-radars-uewr/>.

⁴¹⁰ Missile Defense Advocacy Alliance (MDAA), "Upgraded Early Warning Radars (UEWR)."

United States' UEW system are located in Clear Air Force Station, Alaska, Beale Air Force Base (AFB), California, Cape Cod Air Force Station, Massachusetts, and Royal Air Force (RAF) Fylingdales, United Kingdom.⁴¹¹ In a 2020 DOD News interview, General John W. Raymond, U.S. Space Force Chief of Space Operations, emphasized the importance of Thule Air Base to U.S. homeland defense, stating, "If you look at one of the most critical missions that we do, and that's missile warning, the Arctic is our front edge of that mission. We do that mission at Thule, Greenland, north of the Arctic Circle, with our space professionals that are assigned there at Thule Air Base."⁴¹²

Additionally, the Kingdom of Denmark possesses three Iver Huitfeldt class frigates with Signal Multibeam Acquisition Radar for Targeting L-Band (SMART-L) air and surface radars capable of targeting ballistic missiles at an advertised range of 1,000 km.⁴¹³ In an interview from 2020, Captain Claus Andersen, head of the capabilities division and executive member in the Maritime Theater Missile Defense (MTMD) forum from the Royal Danish Navy, commented, "as part of our Arctic strategy we have had a frigate in the Arctic. The Iver Huitfeldt class frigate *Peter Willemoes* went up into the Denmark Straits and to Nuuk and up to Disko Bay on the western part of Greenland."⁴¹⁴ Within the interview, he emphasized the importance of an integrated air and missile defense (IAMD) network in the North Atlantic and the Arctic with NATO allies and in particular the United States. However, he also noted that although Denmark could achieve similar results through the procurement of the AEGIS combat system to meet interoperability needs, "we need to find a way where we can cooperate...with the U.S. as our main partner, but also to

⁴¹¹ Missile Defense Advocacy Alliance (MDAA), "Upgraded Early Warning Radars (UEWR)."

⁴¹² C. Todd Lopez, "Air Force Reveals Cold Facts on New Arctic Strategy," U.S. Department of Defense News, last modified July 21, 2020, <https://www.defense.gov/Explore/News/Article/Article/2281961/air-force-reveals-cold-facts-on-new-arctic-strategy/>.

⁴¹³ "SMART-L Radar (The Netherlands and Others): U.S. Partners – Air Defense, Missile Defense, Sensor," Missile Defense Advocacy Alliance (MDAA), last modified December 2018, accessed May 24, 2021, <https://missiledefenseadvocacy.org/defense-systems/smart-l-radar-the-netherlands-and-others/>.

⁴¹⁴ Edward H. Lundquist, "Royal Danish Navy Growing into New Missile Defense Role: An Interview with Capt. Claus Andersen, Royal Danish Navy," Defense Media Network, last modified January 15, 2020, <https://www.defensemmedianetwork.com/stories/royal-danish-navy-growing-into-new-missile-defense-role/>.

keep Danish industry in...[and] cooperate with our European partners.”⁴¹⁵ This focus has seen the Kingdom of Denmark integrated into the NATO ballistic missile defense (BMD) mission since 2014, with Denmark advertising that one SMART-L radar system can cover all of the Kingdom of Denmark’s Arctic territory.⁴¹⁶ As part of the agreement between NATO and Denmark in 2014, “Denmark intends to contribute at least one frigate outfitted with a radar system to the NATO BMD mission.”⁴¹⁷

c. Space Situational Awareness

Similar to the BMD mission area above, the Kingdom of Denmark, via Greenland, has also contributed to the SSA mission area since the 1960s through collaboration at the joint Danish and American Thule Air Base. During the radar site’s primary operations to provide early warning and missile defense, the radar also contributes to space surveillance and space control missions that get coordinated through the U.S. space surveillance network (SSN). The U.S. Space Force’s 12th Space Warning Squadron (SWS) stationed at Thule Air Base conducts space surveillance and space control missions by detecting and tracking polar-orbiting satellites from the UEWR system.⁴¹⁸ According to the U.S. Space Force, the 12th SWS under Space Delta 4 is responsible for providing “space surveillance data on earth-orbiting objects to the 18th Space Control Squadron at Vandenberg Space Force Base, California, in support of United States Space Command’s space control missions.”⁴¹⁹ The UEWR system classifies space objects and operates in the ultra-high frequency band (UHF) with an active aperture of 84 ft. diameter with an overall radar

⁴¹⁵ Lundquist, “Royal Danish Navy Growing into New Missile Defense Role.”

⁴¹⁶ Abel Romero, “Denmark: Onboard with NATO Missile Defense?” *Real Clear Defense*, last modified December 4, 2016, https://www.realcleardefense.com/articles/2016/12/05/denmark_onboard_with_nato_missile_defense_110436.html.

⁴¹⁷ Romero, “Denmark: Onboard with NATO Missile Defense?”

⁴¹⁸ U.S. Space Force, “Welcome to Thule, “The Top of the World,”” 4–5.

⁴¹⁹ “12th Space Warning Squadron,” U.S. Space Force, last modified July 28, 2016, <https://www.buckley.spaceforce.mil/About-Us/Fact-Sheets/Article/2291701/12th-space-warning-squadron/>.

height of 120 ft.⁴²⁰ Thule Air Base's radar provides 240 degrees of coverage over the Arctic Ocean and the northern Russian coast with an advertised effective tracking range of up to 3,000 miles or approximately 5,000 kilometers.⁴²¹ Considering most LEO polar-orbiting satellites are at a range between 200 to 1000 km, the capability and location of this radar facility are critical to the BMD and SSA missions within the Arctic.⁴²²

Although the Kingdom of Denmark does not maintain a national SSA program, it is a participating member state in ESA SSA Programme.⁴²³ Similar to Norway discussed previously, through ESA SSA Programme, Denmark contributes to monitoring and predicting space weather, detecting near-Earth objects (NEO), and conducting space surveillance and tracking (SST) through an integrated network of participating European member state's space infrastructure.⁴²⁴ Additionally, in April 2018, the Danish Ministry of Defense signed an agreement with USSTRATCOM (now with USSPACECOM) to share SSA services and information.⁴²⁵ At the time, Major General Agner Rokos, on behalf of the Danish Defence Command and the Danish Ministry of Defence, emphasized the strategic importance of the agreement. He stated, "For Denmark as an emerging space nation, partnerships are highly valuable. The signing of the agreement to share Space

⁴²⁰ "Fact Sheet: Upgraded Early Warning Radars, AN/FPS-132," U.S. Missile Defense Agency, accessed May 24, 2021, <https://www.mda.mil/global/documents/pdf/uewr1.pdf>

⁴²¹ Valerie Insinna, "Watch the Skies: How a U.S. Base in Greenland Tracks Ballistic Missiles," DefenseNews, last modified August 4, 2019, <https://www.defensenews.com/smr/a-modern-nato/2019/08/05/watch-the-skies-how-a-us-base-in-greenland-tracks-ballistic-missiles/>; Missile Defense Advocacy Alliance (MDAA), "Upgraded Early Warning Radars (UEWR)."

⁴²² "Types of Orbits," The European Space Agency, last modified March 30, 2020, http://www.esa.int/Enabling_Support/Space_Transportation/Types_of_orbits#SSO.

⁴²³ The European Space Agency, "SSA Programme Overview."

⁴²⁴ The European Space Agency, "SSA Programme Overview."

⁴²⁵ U.S. Strategic Command Public Affairs, "USSTRATCOM, Denmark Sign Agreement to Share Space Services, Data," U.S. Strategic Command, last modified April 18, 2018, <https://www.stratcom.mil/Media/News/News-Article-View/Article/1497343/usstratcom-denmark-sign-agreement-to-share-space-services-data/>.

Situational Awareness ensures not only information sharing but will further build on the close relationship between USSTRATCOM and the Danish Defence.”⁴²⁶

Furthermore, Denmark’s research-based satellite manufacturer GomSpace is a participating member in the European Commission’s proposal for a future European space traffic management (STM) capability.⁴²⁷ The EU’s Horizon 2020 research and innovation program seeks to “strengthen the European public and private space sector, encourage an innovative, competitive, and profitable space industry, as well as a research community that develops and runs space infrastructure.”⁴²⁸ Although the program acknowledges the significant partnerships European nations within the EU and ESA have with the United States through SSA and STM information and data sharing agreements, the EU’s STM program seeks a European alternative. The proposal highlights European interests, “to ensure sovereignty, autonomy and leadership in this domain whilst reducing this dependability, the European Commission started to work on an independent SSA/SST capability.”⁴²⁹ As with its other space-based programs, Denmark leverages its membership in the EU, NATO, and the Arctic Council to ensure its scientific, security, and economic space interests are met through international collaboration. This additional STM capability has the potential to provide additional capacity to a crucial U.S. mission area within the Arctic.

d. Space Ground Infrastructure

Much like the BMD and SSA mission areas above, the Kingdom of Denmark, via Greenland, contributes to the United States’ polar telemetry, tracking, and command

⁴²⁶ U.S. Strategic Command, “USSTRATCOM, Denmark Sign Agreement to Share Space Services, Data.”

⁴²⁷ “GMV Consolidates its Space Traffic Management Leadership: EUSTM,” GMV Innovating Solutions, last modified February 17, 2021, <https://www.gmv.com/en/Company/Communication/News/2021/02/EUSTM.html>

⁴²⁸ GMV Innovating Solutions, “GMV Consolidates its Space Traffic Management Leadership: EUSTM.”

⁴²⁹ GMV Innovating Solutions, “GMV Consolidates its Space Traffic Management Leadership: EUSTM.”

(TT&C) capability within the Arctic. Since the 1960s, Thule Air Base has hosted an Air Force satellite command and control facility to track and communicate with DOD, government, and allied satellites in polar orbit.⁴³⁰ Thule Air Base in Greenland host a U.S. AFSCN node approximately 3.5 miles northeast of the main base.⁴³¹ The AFSCN node is operated by Detachment 1, 23rd Space Operations Squadron (SOPS) which reports to the 50th Space Wing at Schriever Air Force Base.⁴³² According to the U.S. Space Force, “their primary function is to track and communicate with satellites in polar orbit as part of the Air Force Satellite Control Network.”⁴³³ This AFSCN node provides TT&C services for over 195 satellites operated by the U.S. DOD, government, and allies.⁴³⁴ In a 2020, DOD News interview, General Raymond, Chief of Space Operations, stressed the geographical advantage Greenland provides to space operations, stating, “If you look at the key terrain aspect of that environment, we also command and control satellites. If you’re going to command and control satellites that are in polar orbits...that geography and the position on the globe...makes it an extremely advantageous place to operate from.”⁴³⁵

However, it should be noted that the Kingdom of Denmark does not own or operate any national space ground infrastructure outside of the access it provides to the United States and NATO. A PWC report from 2017 on analyzing satellite infrastructure needs within the Kingdom of Denmark, highlighted that “Denmark has no common satellite data infrastructure, and Danish users retrieve data according to ability and need through different providers.”⁴³⁶ Although Denmark does not possess national space ground

⁴³⁰ U.S. Space Force, “Welcome to Thule, “The Top of the World,”” 31.

⁴³¹ U.S. Space Force, 6.

⁴³² “Det 1, 23 SOPS,” U.S. Space Force, accessed May 27, 2021, <https://www.schriever.spaceforce.mil/News/Photos/igphoto/2001258897/>.

⁴³³ U.S. Space Force, “Det 1, 23 SOPS.”

⁴³⁴ U.S. Space Force, “Welcome to Thule, “The Top of the World,”” 3.

⁴³⁵ C. Todd Lopez, “Air Force Reveals Cold Facts on New Arctic Strategy.”

⁴³⁶ PWC, “Analysis of a Common Satellite Data Infrastructure: The Agency for Data Supply and Efficiency & The Danish Meteorological Institute” (Copenhagen, DK, PWC, 2017), 5, <https://sdfe.dk/media/2918702/management-summary-satellite-data-infrastructure.pdf>.

infrastructure within its territory, it is a significant consumer of space-generated information and space infrastructure in the Arctic through multiple collaborative initiatives through ESA, the EU, NATO, and bilateral partnerships. However, a Danish Ministry of High Education and Science report from 2020 highlighted Danish governmental agencies' desire to establish a ground station in Greenland, create datahubs for space-generated information, and increase space ground infrastructure to mitigate "inadequate geographic coverage, timeliness and the price of the data."⁴³⁷ Subsequently, in February 2021, a Danish political agreement between the governments of Denmark, Greenland, and the Faroe Islands to fund Danish Arctic defense capabilities, allocated approximately 10 million U.S. dollars to fund a proposed ground station and coastal radars in Greenland.⁴³⁸

C. NATO AND THE ARCTIC

As a possible alternative to bilateral or regional cooperation amongst the Arctic states, this section highlights a possible intergovernmental solution that addresses the second posed hypothesis within Chapter One. Part C discusses building intergovernmental space collaborative capacity within the Arctic through NATO cooperation. As the above case studies show, NATO member states within the Arctic possess niche capabilities that could be leveraged to create an allied space network within the Arctic. This section seeks to answer how the United States might leverage its cooperation with the North Atlantic Treaty Organization (NATO) to benefit from an alliance space policy for the Arctic and whether NATO can build space collaborative capacity amongst its members and partners within the Arctic to support its stated strategic objectives in an era of polar great power competition. Although the space domain is outside of the geographic region defined in Article 6 of the North Atlantic Treaty,⁴³⁹ NATO's 2030 policy highlights that the dynamic

⁴³⁷ Ramboll, *Mapping of the Kingdom of Denmark's Users of Space Generated Information and Space Infrastructure in the Arctic*, 4.

⁴³⁸ Danish Ministry of Defence, *Agreement on Arctic Capabilities*.

⁴³⁹ Article 6 of the North Atlantic Treaty specifies that "an armed attack on one or more of the Parties signed to the treaty is deemed to include an armed attack: on the territory of any of the Parties in Europe or North America, on the Algerian Departments of France, on the territory of Turkey or on the Islands under the jurisdiction of any of the Parties in the North Atlantic area north of the Tropic of Cancer." "The North Atlantic Treaty," NATO, last modified April 10, 2019, <https://www.nato.int/cps/en/natohq/>.

and rapidly evolving nature of the domain, combined with the opportunities it presents, “have made outer space a new theatre for geopolitical competition.”⁴⁴⁰ In July 2018, at the Brussels Summit, allied leaders issued a declaration recognizing space as “essential to a coherent Alliance deterrence and defense posture, [and] have agreed to develop an overarching NATO Space Policy.”⁴⁴¹ By December of 2019, allied leaders not only agreed on such a policy but also recognized space as a new operational domain.⁴⁴² Although NATO’s space policy is not region-specific due to the cross-boundary nature of the space domain, this section investigates how a comprehensive alliance space policy specific to the Arctic region would address the United States’ Arctic-specific challenges with member states and partners that have vested interests in Arctic affairs. Like NATO’s approach to its south, NATO could articulate a consistent, clear, and coherent approach to its North.⁴⁴³ Such a strategy could stimulate regional space cooperation and support collaborative efforts through resource investment in shared regional objectives through multilateral cooperation.

As discussed previously, space solutions are uniquely qualified to meet the harsh operating environment in the Arctic with their reduced physical footprint, large coverage areas, and ability to span across international boundaries. As highlighted in NATO’s recent space policy, “the information gathered and delivered through satellites is critical for NATO activities, operations and missions, including collective defense, crisis response, and [cooperative security].”⁴⁴⁴ Due to the nascent and emerging space programs of many of NATO’s Arctic members and partners, coupled with the competition for resources due

⁴⁴⁰ North Atlantic Treaty Organization, “NATO 2030: United for a New Era.” *Analysis and Recommendations of the Reflection Group Appointed by the NATO Secretary General* (Brussels: NATO, 2020), 47, https://www.nato.int/nato_static_fl2014/assets/pdf/2020/12/pdf/201201-Reflection-Group-Final-Report-Uni.pdf.

⁴⁴¹ North Atlantic Treaty Organization, “Brussels Summit Declaration: Issued by the Heads of State and Government Participating in the Meeting of the North Atlantic Council in Brussels 11–12 July 2018,” NATO, last modified August 30, 2018, https://www.nato.int/cps/en/natohq/official_texts_156624.htm.

⁴⁴² North Atlantic Treaty Organization, “NATO’s Approach to Space,” NATO, last modified April 22, 2021, https://www.nato.int/cps/en/natohq/topics_175419.htm.

⁴⁴³ NATO, “NATO 2030: United for a New Era,” 13.

⁴⁴⁴ NATO, “NATO’s Approach to Space.”

to the competing strategic requirements of the United States, an alliance space policy for the Arctic would focus on space force enhancement to include intelligence, surveillance, and reconnaissance, shared early warning, terrestrial and space environmental monitoring, satellite communications, and PNT. These capabilities directly address NATO's strategic capability gaps and limited capacity in C3ISR inclusive of limited domain awareness, satellite communications and PNT services. A comprehensive alliance space policy for the Arctic would provide region specific solutions by, with, and through member and partner countries with interest in Arctic affairs.

The adoption of an alliance space policy for the Arctic as an alternative to only bilateral agreements would be an evolutionary adaptation for the alliance commensurate with NATO's expansion into other mission areas. As pointed out in John R. Deni's work on NATO's enduring presence, this capabilities aggregate model seeks to balance externally by aggregating the capabilities of individual states, "allowing them to each leverage the collective capabilities of the whole and thereby better their security situation."⁴⁴⁵ Similar to the Mediterranean Dialogue highlighted within the NATO 2030 policy, an Arctic Dialogue emphasizing an alliance space policy for the region, and leveraging Deni's ideas, could "build regional security and stability and achieve better mutual understanding amongst member states."⁴⁴⁶ Arctic participants could "engage with NATO both collectively and individually, including in political dialogue on current space security issues."⁴⁴⁷ Additionally, related to Deni's ideas, Arctic participants could "develop individual cooperative programs with NATO, outlining the array of activities or events they could engage in, including [space] defense planning and [organization] reform, observation of and participation in exercises, intelligence sharing, [combined acquisition programs, and cooperation in civil space programs]."⁴⁴⁸

⁴⁴⁵ John R. Deni, "Staying Alive by Overeating? The Enduring NATO Alliance at 70," *Journal of Transatlantic Studies* 17(2): March 18, 2019, 157–73, 164, <https://doi.org/10.1057/s42738-019-00012-2>.

⁴⁴⁶ NATO, "NATO 2030: United for a New Era," 59; Deni, "Staying Alive by Overeating? The Enduring NATO Alliance at 70," 161.

⁴⁴⁷ Deni, "Staying Alive by Overeating? The Enduring NATO Alliance at 70," 161.

⁴⁴⁸ Deni, 161.

In line with the NATO 2030 report, NATO “should shift from the current demand-driven approach to an interest-driven approach and consider providing more stable and predictable resource streams for partnership activities.”⁴⁴⁹ A capabilities-based and interest-driven approach to build allied and partner space collaborative capacity within the Arctic could provide an evolutionary concept that drives operational requirements across the combined allied and partner force, with key interest in Arctic affairs, to field capabilities that can provide a mutually beneficial competitive advantage within the region.⁴⁵⁰ Although the adoption of a NATO space policy and the declaration of space as an operational domain is an evolutionary adaptation and is commendable as a step forward, it may require a complementary and comprehensive implementation strategy specific to countries with key interests to receive tangible results. As NATO considers its role and responsibilities in the space domain specific to polar great power competition, as well as its role in complementing the EU members states’ Arctic strategies, NATO could seek complementary solutions that prevent unnecessary duplication of efforts and waste resources that prevent interoperability and aggregation of capabilities. As highlighted in the NATO 2030 report, “Rather than developing new mechanisms... concerted effort is needed to build trust and make fuller use of existing arrangements and identified areas of cooperation.”⁴⁵¹

Fortunately, as discussed previously, NATO is well established in the Arctic with a considerable network of members and partners within and around the Arctic region. Member states contribute to space activities in the Arctic through bilateral cooperation like NORAD and the areas of cooperation mentioned earlier in this chapter. Additionally, intergovernmental cooperation through the EU, ESA, NORDEFCO, and the Five Eye intelligence-sharing alliance provide avenues to encourage burden-sharing and addressed areas of mutual interest within the space domain. This intricate network of alliances and

⁴⁴⁹ NATO, “NATO 2030: United for a New Era,” 15.

⁴⁵⁰ Scott Jasper, “The Capabilities-Based Approach,” *Transforming Defense Capabilities* (Boulder: Lynne Rienner Publishers, 2009), 18–19.

⁴⁵¹ NATO, “NATO 2030: United for a New Era,” 55.

partnerships within the Arctic provides existing intergovernmental forums and multilateral cooperative security initiatives for NATO to nest its stated objectives within the space domain.

As highlighted within the NATO 2030 policy, but applied to the Arctic, NATO could “put itself at the centre of [this] informal system of overlapping organizations and bilateral/multilateral relationships to respond to threats and stabilise the region.”⁴⁵² Alyson Bailes, a foreign policy expert and professor at the University of Iceland, pointed out in 2010, that the current Arctic community “cannot lobby in NATO as a bloc because of Swedish and Finnish non-membership.”⁴⁵³ Additionally, she highlighted that “the region’s countries that do have a ‘vote’ in NATO are among the Alliance’s smallest members in population terms.”⁴⁵⁴ However, this extensive network of partnerships has seen numerous regional exercises both within the EU and NATO, with standing military forces dedicated to the area. Currently, the EU possesses the Nordic Battlegroup supporting the Common Security and Defence Policy (CSDP) of the EU.⁴⁵⁵ Although not an EU nation, Norway contributes forces to this expeditionary force in readiness. As an effort to operate autonomously outside of NATO on security matters, if necessary, the EU Nordic Battlegroup along with NORDEFCE and NORAD, are clear indications from regional partners that regional security and issues will move ahead regardless of NATO insistence and resourcing. Although NATO’s Arctic members and partners, apart from the United States, individually have little ambition to become significant space players, collectively

⁴⁵² NATO, 59.

⁴⁵³ Alyson J.K. Bailes, “NATO and the EU in the North: What Is at Stake in Current Strategy Development?” *Lithuanian Foreign Policy Review*, no. 23 (2010): 8–28, 23, https://www.nato.int/strategic-concept/pdf/NATO_EU_North.pdf.

⁴⁵⁴ Alyson J.K. Bailes, “NATO and the EU in the North: What is at Stake in Current Strategy Development?” 23.

⁴⁵⁵ Jan Joel Andersson, “If Not Now, When? The Nordic EU Battlegroup,” *European Union Institute for Security Studies* (February 2015): 1–2, https://www.iss.europa.eu/sites/default/files/EUISSFiles/Alert_11_Nordic_Battlegroup.pdf.

they have the potential to significantly increase their aggregate capabilities and perhaps their relative standing regarding others in Europe.⁴⁵⁶

In considering the challenges of an alliance space policy for the Arctic, understanding the geopolitical interests of the respective countries is important as well as the domestic politics. Although, there are significant issues that NATO must overcome to implement an alliance space policy for the Arctic, Arctic nations have historically been more open to cooperation than their larger European space counterparts due to their common interests, limited military capacity, and shared principles of democratic ideals. A key challenge that must be overcome is what Olivier Schmitt describes as quality amongst potential partners within the region.⁴⁵⁷ Schmitt states, “a country lacking in at least some recent technologies will face interoperability problems with other countries in a gradually integrated battlefield.”⁴⁵⁸ Member and partner nascent and emerging space programs will lack exquisite capabilities, but what they lack in capability, can be mitigated by an interest-driven approach. Additionally, expansion of NATO in the Arctic has historically been escalatory to Russia and has been limited to maintain a low-tension cooperative sphere between Russia and its western counterparts in the Arctic. The dual-use domain of space could mitigate this escalation with the right messaging across allied and partner civil, commercial, and defense agencies focusing space solutions on terrestrial monitoring, communications, and force-enhancement capabilities that provide benefits across the harsh Arctic operating environment. Furthermore, Deni highlights that, “NATO’s member states often have different security interests, threat perceptions, and strategic objectives.”⁴⁵⁹

⁴⁵⁶ James Clay Moltz, *Asia’s Space Race: National Motivations, Regional Rivalries, and International Risks* (New York: Columbia University Press, 2012), 159.

⁴⁵⁷ Olivier Schmitt, “More Allies, Weaker Missions? How Junior Partners Contribute to Multinational Military Operations,” *Contemporary Security Policy*, 40:1, 70–84, July 24, 2018, 71, <https://doi.org/10.1080/13523260.2018.1501999>.

⁴⁵⁸ Schmitt, “More Allies, Weaker Missions? How Junior Partners Contribute to Multinational Military Operations,” 74.

⁴⁵⁹ Deni, “Staying Alive by Overeating? The Enduring NATO Alliance at 70,” 169.

However, Deni emphasized, in the end “they all look to NATO as a primary means of fulfilling their interests and meeting their objectives.”⁴⁶⁰

Mutually beneficial alliances and partnerships are crucial to building an alliance space policy for the Arctic. Space power theorist and policy expert, Clay Moltz, emphasizes the benefits of shared space situational awareness and collective military action stating, “This ‘community policing’ approach is one that has never before been attempted in space, but it may succeed because of shared military interests in maintaining safe access to the valuable information that travels through space and the unique observations possible from space-based assets.”⁴⁶¹ The United States could benefit from a NATO focused on building space collaborative capacity within the Arctic that leverages members and partners and deters potential adversaries from hostile military activities against member interests in the Arctic. The 2020 U.S. Defense Space Strategy emphasized, “space-based capabilities are integral to modern life in the United States and around the world and are an indispensable component of U.S. military power. Ensuring the availability of these capabilities is fundamental to establishing and maintaining military superiority across all domains and to advancing regional security and economic prosperity.”⁴⁶² The same can be said about NATO and space capabilities within the Arctic. Retaining a competitive advantage in the Arctic is a strategic choice. As NATO grapples with competing budgetary requirements, rising polar great power competition, and significant capability gaps within the region, it cannot assume that its northern flank will continue to be protected in the absence of sustained attention to both policy and investment choices. NATO will eventually have to choose whether to adapt and seek to build a collaborative comprehensive space capacity or succumb to the geostrategic realities of the emerging Arctic security environment.

⁴⁶⁰ Deni, 169.

⁴⁶¹ James C. Moltz, *Crowded Orbits: Conflict and Cooperation in Space* (New York, NY: Columbia University Press, 2018), 144.

⁴⁶² Department of Defense, *Defense Space Strategy Summary*, 1.

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V. CONCLUSION

This thesis sought to answer how the United States might benefit from a cooperative space strategy for the Arctic and whether the United States must build space collaborative capacity within the Arctic to achieve its stated strategic objectives within the region. Although it is clear from the evidence presented that the United States has the resources, infrastructure, and technological capability to address Arctic capability gaps through national space-based solutions, competing requirements and constrained budgets have consistently limited the success of such national initiatives. This chapter summarizes the presented research and analyzes the case studies presented in Chapter Four against the opportunities and challenges of building U.S. allied and partner space collaborative capacity within the Arctic. Additionally, the proposed hypotheses for answering the major research question are revisited and evaluated based on gathered quantitative and qualitative data. Furthermore, areas for enhanced cooperation are identified based on shared political objectives, historic areas of collaboration, and political will as expressed by current space strategies and policies of allies and partners within the region.

A. SUMMARY OF RESEARCH

Space collective action between U.S. allies and partners within the Arctic must first start by recognizing shared geopolitical objectives and shared capability shortfalls. Recent U.S. strategic focus on the Arctic and the space domain sees progress in implementing a collaborative space concept. In 2016, Ash Carter, then U.S. Secretary of Defense, stated, “From secure communications, to reconnaissance satellites, to allowing for precise navigation and targeting, space is integral to our operations... [It is] in the self-interest of every nation to advance the common interest of a free and stable environment in space.”⁴⁶³ This point was further emphasized with NATO declaring space an operational domain in December 2019, recognizing emerging threats from competing great powers and the

⁴⁶³ Ash Carter, Secretary of Defense, “Securing the Oceans, the Internet, and Space,” Speech to Commonwealth Club, Silicon Valley, March 1, 2016, 13–14, <https://www.defense.gov/Newsroom/Speeches/Speech/Article/684118/remarks-on-securing-the-oceans-the-internet-and-space-protecting-the-domains-th/>.

necessity to collectively defend strategic assets within the space domain and enhance space security cooperation to support national, joint, and combined operations.⁴⁶⁴

The United States recognizes the geostrategic challenges within the Arctic, has communicated its strategic objectives to build allied and partner space collaborative capacity, and sees key partners reciprocate with a recognition of shared objectives. The 2017 DOD International Space Cooperation Strategy codified

the DOD's approach for invigorating cooperation and collaboration with trusted allies and partners across the spectrum of DOD's space-related activities and mission areas. The key purposes for this expanded international space cooperation and collaboration are expanded interoperability, sustainability, mission assurance, and assured access to critical capabilities in crisis and contingency operations.⁴⁶⁵

Additionally, the 2020 Defense Space Strategy continues to emphasize the strategic importance of “a robust and prolific arrangement of alliances and partnerships built on trust, common values, and shared national interests. This approach creates an important advantage for the United States and its allies and partners.”⁴⁶⁶ Although these emerging space security cooperation initiatives primarily represent an application of the military instrument of national power, a comprehensive security cooperation plan inclusive of all instruments of national power (diplomatic, informational, and economic) across the U.S. civil, commercial, and defense sectors is necessary to build U.S. allied and partner space collaborative capacity in the Arctic.⁴⁶⁷ A comprehensive space cooperation concept would seek to enhance allied and partner space capacity and capabilities, provide access for terrestrial infrastructure supporting space capabilities and build partner nation support of U.S. interests in the Arctic through bilateral, interorganizational, and regional collaborative forums.

⁴⁶⁴ North Atlantic Treaty Organization “NATO’s Approach to Space.”

⁴⁶⁵ Department of Defense, *Department of Defense International Space Cooperation Strategy*, 1.

⁴⁶⁶ Department of Defense, *Defense Space Strategy Summary*, 5.

⁴⁶⁷ Joint Chiefs of Staff, *Security Cooperation*, JP 3-20, I-4.

Recognizing the increasingly congested nature of the space domain, the United States has signed space data-sharing agreements that contribute to SSA and space traffic management (STM) with over 26 countries worldwide, inclusive of Arctic states Canada, Denmark, Finland, and Norway as of May 2021.⁴⁶⁸ Moreover, in 2014, the U.S. Strategic Command (USSTRATCOM) and the European Space Agency (ESA) signed a space data-sharing agreement to exchange PNT data, radio-frequency information, and planned orbital maneuvers of some European satellites.⁴⁶⁹ Denmark, Finland, Norway, and Sweden are member states of ESA with Canada holding a special status as a Cooperating State. Additionally, Iceland began its path to membership in 2017.⁴⁷⁰ Furthermore, ESA is developing the Space Situational Awareness Programme with 19 member states (inclusive of Denmark, Finland, Sweden, and Norway) and in collaboration with the U.S. Space Force and the Department of Commerce.⁴⁷¹

The current geostrategic operating environment within the Arctic requires space-based solutions for the United States and its allies and partners within the region to communicate, navigate, and maintain awareness to achieve relevant national security, civil, environmental, and economic goals. Whether this is accomplished through national means, bilateral engagement, multilateral cooperation, or through intergovernmental forums will be determined by the United States, as its peer-competitors will fill the leadership vacuum if the United States does not meet the moment.

Emerging space collaborative concepts coming out of recent presidential administrations established the structure, created the reward system, and implemented

⁴⁶⁸ Sandra Erwin, “U.S. Space Command Signs Space Data-Sharing Agreement with Peru,” SpaceNews, last modified May 20, 2020, <https://spacenews.com/u-s-space-command-signs-space-data-sharing-agreement-with-peru/>.

⁴⁶⁹ Mike Gruss, “U.S. Strategic Command, ESA Sign Space Surveillance Data-sharing Agreement,” SpaceNews, last modified October 31, 2014, <https://spacenews.com/42384us-strategic-command-esa-sign-space-surveillance-data-sharing-agreement/>.

⁴⁷⁰ “European Space Agency and Iceland Consider Partnership,” *Iceland Review*, last modified November 8, 2017, <https://www.icelandreview.com/news/european-space-agency-and-iceland-consider-partnership/>.

⁴⁷¹ “SSA Programme Overview,” Safety & Security, The European Space Agency, accessed May 5, 2021, 1, https://www.esa.int/Safety_Security/SSA_Programme_overview.

coherent policies to enact real change in the region. However, the emerging concepts were largely underfunded, unfocused, and lacked the domestic political willpower to see significant shift in budgets towards increasing capability within the region significantly. With continued expansion of space-data sharing agreements along with established norms within the space domain amongst allies and partners, they will likely increase information sharing, establish best practices, and encourage interoperability amongst themselves going forward. Whether this continued engagement will exceed the current status quo is yet to be seen. The Biden administration's direction in space policy and Arctic affairs will drive future U.S. space collective action amongst Arctic allies and partners and dictate whether the political will is present to allocate the required resources to address U.S. strategic capability gaps within the region. If it does not, Russia and China will likely take the opportunity to solidify their gains, expand their influence, and make the situation significantly more challenging for the next administration.

B. CASE STUDY ASSESSMENT

This thesis examined the possible contributions of Norway and Denmark within the Arctic to assess how the United States might benefit from allied and partner space cooperation in the region. Based on the evidence within the case study on Norwegian space activities, Norway can make a significant contribution to both the United States and NATO's space security initiatives within the Arctic. Norwegian contributions to Arctic communications, launch facilities, Arctic domain awareness, SSA, and space ground infrastructure provide avenues to build space collaborative capacity through key mission areas that could benefit a cooperative space strategy to address U.S. strategic capability gaps within the region. Due to Norway's unique proximity to the polar region and its extensive maritime area of responsibility, the evidence suggests that Norway could be a gateway to the Arctic and the polar space above it. Based on the evidence presented within the chapter, it is likely that Norwegian and United States bilateral cooperation in space activities should expand.

Additionally, based on the evidence within the case study on the Kingdom of Denmark's space activities, Denmark has been integral to the BMD, SSA, TT&C and

domain awareness mission areas of NATO and the United States within the Arctic since the late 1950s. Its geographically advantageous position along the transpolar corridor puts it at a strategic crossroads for polar great power competition and makes it an ideal location for space surveillance of polar orbiting satellites. Based on the evidence presented within the chapter, there is a strong need for continued cooperation between Denmark and the United States in the above mission areas. However, it must be noted that the Kingdom of Denmark is an Arctic state via Greenland. If Greenland seeks full independence from Denmark, the United States will require future negotiations with Greenland to sustain space collaboration initiatives and reaffirm land use agreements.

Furthermore, the analysis on NATO in the Arctic highlighted the mutual interests of Arctic allies and partners within the region. Based on the evidence within the chapter, as a possible alternative to bilateral or regional cooperation, the United States could benefit from a NATO focused on building space collaborative capacity within the Arctic that leverages members and partners and deters potential adversaries from hostile military activities against member interests in the Arctic. Although Canada has previously been a major detractor of NATO involvement in the Arctic due its reluctance for military intervention in the region, recent Russian and Chinese emerging competition in the region has seen Canada advocate for more NATO involvement.⁴⁷² This, combined with consistent Norwegian advocacy of greater NATO involvement, should encourage the United States to leverage its transatlantic partnerships to generate greater Arctic presence and investment in space-based solutions.

As a possible alternative to bilateral or regional cooperation amongst the Arctic states, this section highlights a possible intergovernmental solution that addresses the second posed hypothesis within Chapter One.

⁴⁷² Andrea Charron, "NATO, Canada and the Arctic," Canadian Global Affairs Institute, last modified September 2017, https://www.cgai.ca/nato_canada_and_the_arctic.

C. EVALUATION OF THE HYPOTHESES

Based off the initial literature review, this thesis introduced three possible hypotheses for how the United States could best build space collaborative capacity and benefit from space cooperation in the Arctic. The first hypothesis proposed that the Arctic would likely remain a region of cooperation between the Arctic states, with the United States loosely benefiting from established cooperative norms within the region. Based on the evidence presented within the thesis, ongoing space collaborative initiatives between Canada, Denmark, Norway, Finland, and the United States within the space domain through civil, commercial, and defense space cooperation initiatives are witnessing greater regional space collaborative efforts to address Arctic specific concerns. Although commercial solutions like proliferated LEO satellite constellations and high-altitude platforms may solve communications, Earth Observation, and PNT issues in the future, current initiatives for partnered investments to address shared regional challenges are increasing collaboration across the emerging defense and industrial space activities. Increased burden sharing through Arctic allied and partner niche capabilities and geographic advantages provide an avenue to address U.S. strategic capability gaps within the region. This would suggest that the Arctic is becoming a region of competition with the changing strategic environment, and U.S. allies and partners within the region are willing to engage in bilateral and multilateral approaches to address shared concerns within the Arctic.

The second hypothesis proposed that longstanding Arctic intergovernmental forums could provide the structure necessary to stimulate regional space cooperation and support collaborative efforts through resource investment in shared regional objectives through multilateral cooperation. Evidence presented within the thesis, highlights intergovernmental forums that are addressing Arctic challenges through their respective shared regional interests. These include NATO, NORAD, the UN, EU, ESA, NORDEFCO, and the Nordic Council amongst others. Bilateral and multilateral space agreements will likely contribute to strengthening regional cooperation and increase U.S. allied and partner civil, commercial, and military space capabilities to promote peace and stability within the region, and ultimately advance U.S. national interests within the Arctic. An important

question that must be answered is not whether the U.S. should engage in space cooperation initiatives within the Arctic region, but rather, can the U.S. afford not to lead, considering the growing threat posed by the emerging polar great power competition and the geostrategic advantage space capabilities provide to the region's security?

A recent example of the United States leading an Arctic cooperative forum is the International Cooperative Engagement Program for Polar Research (ICE-PPR). According to the U.S. Office of Naval Research, "The International Cooperative Engagement Program for Polar Research (ICE-PPR) is an agreement between the partner nations' defense departments and government agencies engaged in polar research to help advance polar science and technology."⁴⁷³ Participating Arctic nations include the defense agencies of Canada, Denmark, Finland, New Zealand, Norway, Sweden, and the United States. Although the working group is primarily focused on "environment, human performance, platforms, and situational awareness" within the Arctic, the fact that Sweden is participating in an Arctic defense collaborative forum contributing to space activities is a significant step forward. Sweden's recent Arctic strategy published in 2020, further emphasized that "Sweden's close relationship with the U.S. is of central importance for Sweden's security and prosperity."⁴⁷⁴ The strategy goes on to say that "Sweden wants to strengthen cooperation especially in the areas of polar research, innovation, trade, climate and the environment."⁴⁷⁵ These areas are consistent with Sweden's stance on a cooperative Arctic focused on scientific and environmental collaboration. In fact, since Russia's invasion of Crimea in 2014, Sweden has increased its defense cooperation with the United States.

⁴⁷³ "International Cooperative Engagement Program for Polar Research (ICE-PPR) Self-Forming Team: Advancing polar science and technology through international cooperation," IARPC Collaborations, accessed March 12, 2021, <https://www.iarpcollaborations.org/teams/International-Cooperative-Engagement-Program-for-Polar-Research-ICE-PPR-Self-Forming-Team>.

⁴⁷⁴ Government Offices of Sweden, *Sweden's Strategy for the Arctic Region* (Stockholm, SE: Ministry of Foreign Affairs, 2020), 18, <https://www.government.se/4ab869/contentassets/c197945c0be646a482733275d8b702cd/swedens-strategy-for-the-arctic-region-2020.pdf>.

⁴⁷⁵ Government Offices of Sweden, *Sweden's Strategy for the Arctic Region*, 18.

The third hypothesis proposed in the thesis suggested that a more robust Arctic cooperative space strategy might fail to materialize due to a combination of regional specific challenges, such as nationalism, lack of dedicated resources, conflicting political goals, and a lack of sustained political leadership to implement long-term results. Challenges and common barriers to space collective action presented in Chapter Three provided evidence that a coherent and comprehensive strategy amongst the United States' Arctic allies and partners could be difficult to achieve due to the conflicting organizational affiliations, competing domestic interests, and industrial competition related to the space domain. However, the chapter also provided evidence that a cooperative Arctic strategy is still feasible with bold and consistent leadership from the United States.

In an interview with the Defense & Aerospace Report from 2019, Kasper Høeg-Jensen, then the head of Denmark's ministry of defense's security policy and operations department, highlighted Danish leadership to foster closer collaboration between the Nordic nations and the United States. During the interview, he stated, "What we have been pushing for from the Danish side is actually to strengthen the Nordic-U.S. cooperation... We are a region that has different security affiliations, different relationships to the EU, to NATO. But we have a common relationship with the [United States.]"⁴⁷⁶ He went on to state, "NATO is the cornerstone of our security. But whatever we can do to draw Sweden and Finland closer to us and to NATO I think is positive."⁴⁷⁷ Høeg-Jensen's comments reiterate the strong shared political narratives of multilateralism and cooperation embedded in Nordic foreign policy and the shared interest in defense alignment with the United States against Russian and non-Arctic state aggression within the region.⁴⁷⁸

Strong defense relationships between the Nordic countries and the United States reinforce this common relationship. As mentioned previously, Denmark, Iceland, and

⁴⁷⁶ Vago Muradian, "Denmark's Kasper on NATO, Nordic Cooperation, Greenland, China, Climate," Defense & Aerospace Report, accessed May 29, 2021, <https://defaeroreport.com/2019/04/03/denmarks-kasper-on-nato-nordic-cooperation-greenland-china-climate/>.

⁴⁷⁷ Vago Muradian, "Denmark's Kasper on NATO, Nordic Cooperation, Greenland, China, Climate."

⁴⁷⁸ North Atlantic Treaty Organization, *Arctic Narratives and Political Values: Arctic States, China, and NATO*, Prepared by the NATO Strategic Communications Centre of Excellence, ISBN: 978-9934-564-65-9, December 2019, 4-5, https://stratcomcoe.org/cuploads/pfiles/arctic_political_values_11dec2019.pdf.

Norway are founding members of the NATO alliance, and Finland and Sweden are enhanced opportunities partners. Additionally, all five Nordic countries have recently signed separate defense agreements with the United States reinforcing their commitment to Transatlantic security initiatives. In 2004, then-Secretary of State Colin Powell, along with Denmark and Greenland representatives, signed a supplemental defense agreement on Greenland that reinforced bilateral defense commitments and recognized Greenland's change in status "from colony to that of an equal part of the Kingdom of Denmark."⁴⁷⁹ In 2016, the United States and Iceland signed a joint declaration encouraging future cooperation, and the United States "reaffirmed its 65-year-old commitment to the defense of Iceland, while Iceland agreed to continue allowing the United States and NATO to use Icelandic facilities in order to reinforce mutual security."⁴⁸⁰

Additionally, in 2018, Finland, Sweden, and the United States signed a Trilateral Statement of Intent between the respective countries' defense departments that reinforced the strong defense relationships between the partners with an intent to "pursue an enhanced trilateral defense relationship...[that] strengthens respective bilateral defense arrangements, as well as multilateral agreements and arrangements."⁴⁸¹ Furthermore, in April 2021, Antony Blinken, U.S. Secretary of State, signed the Supplementary Defense Cooperation Agreement (SDCA) with Norway. According to the Department of State, "The SDCA builds on the 1951 NATO Status of Forces Agreement to facilitate further development of opportunities for U.S. forces to train and exercise in Norway, promoting improved interoperability with Norwegian and other allied forces."⁴⁸² These agreements

⁴⁷⁹ Department of State, "Agreement to Amend and Supplement the 1951 Agreement on the Defense of Greenland," last modified August 6, 2004, <https://2001-2009.state.gov/p/eur/rls/or/35269.htm>.

⁴⁸⁰ Department of Defense, "U.S., Iceland Sign Security Cooperation Agreement," DOD News, last modified June 30, 2016, <https://www.defense.gov/Explore/News/Article/Article/820904/us-iceland-sign-security-cooperation-agreement/>.

⁴⁸¹ Department of Defense of the United States of America, Ministry of Defence of the Republic of Finland, and Ministry of Defence of the Kingdom of Sweden, "Trilateral Statement of Intent," signed May 7, 2018, https://www.defmin.fi/files/4231/Trilateral_Statement_of_Intent.pdf.

⁴⁸² Department of State, "U.S.-Norway Supplementary Defense Cooperation Agreement [Press Statement]," Antony J. Blinken, Secretary of State, April 16, 2021, <https://www.state.gov/u-s-norway-supplementary-defense-cooperation-agreement/>.

should improve future collaboration and cooperation between the Nordic states and the United States and foster an increased U.S. military presence within the Arctic region.

Although these strong defense relationships have built cooperation through multinational exercises within the Arctic in recent years and encouraged interoperability and increased coordination between the Nordic states and the United States, they have not yet created significant regional cooperation within the space domain. An example would be the Arctic Challenge exercises that include the air forces of the five Arctic states of the United States, Denmark, Finland, Norway, and Sweden as well as participation from Germany, the Netherlands, and the UK. The Arctic Challenge exercises provide cross-border training (CBT) between Sweden, Finland, and Norway, and an opportunity for large-scale aviation maneuvers that develop national capabilities and encourage interoperability.⁴⁸³ Although these exercises do not focus on the space domain, it should be noted that each of the participating Arctic states' have space capabilities within their national Air Forces. This increased collaboration in one mission area could be translated into future opportunities within the space domain. Currently, space collective action has largely been limited to bilateral negotiations on key projects and systems. However, as addressed in the previous chapters, there is a growing trend for regional space collective action initiatives namely amongst Canada, Denmark, Norway, and the United States.

D. AREAS OF FUTURE RESEARCH

Although this thesis covered alliance and space power theory as it relates to the Arctic and space security, there are significant areas of study that this thesis only touched on. Incorporating smaller nations into large alliances and leveraging nascent programs in high-technology initiatives presents unique challenges. Additional areas of research could incorporate these national security affairs themes or deep dive into technical specifications and parameters in solving technical challenges addressing high-latitude operations.

⁴⁸³ "Arctic Challenge Exercise 2021: Nordic Cooperation – in the Concept of Cross Border Training," Swedish Armed Forces, accessed May 29, 2021, <https://www.forsvarsmakten.se/en/activities/exercises/arctic-challenge-exercise-2021/>.

High-latitude operations pose significant challenges to the Joint force's ability to communicate and engage in command and control within the Arctic region. The U.S. military has consistently expressed concern about unreliable communications in the northern polar region as the Arctic lacks a robust land-based and satellite-based communications architecture. In a 2019 statement to Congress, USNORTHCOM prioritized the "Arctic as the front line in the defense of the United States," but the U.S. military continues to underinvest in Arctic communications capabilities due to competing fiscal requirements.⁴⁸⁴ The recent publications of Arctic strategies across the military services and amongst Arctic allies and partners are a testament to the emerging geostrategic importance of the Arctic. The United States should consider leveraging the Homeland Defense Academic Symposium hosted by USNORTHCOM for further research ideas and areas of study.⁴⁸⁵ This symposium gathers academic and industry representatives from the United States and Canada to address NORAD and USNORTHCOM mission areas. Additionally, the United States should continue investment in the Center for Arctic Policy Studies located in Fairbanks, Alaska for Arctic specific research and areas of study related to polar mission areas.⁴⁸⁶

E. CONCLUSION

At an Arctic Council meeting in May 2019, then-U.S. Secretary of State Pompeo articulated the emerging threat in the Arctic when he stated, "the region has become an arena for power and for competition. And the eight Arctic states must adapt to this new future."⁴⁸⁷ The 2019 U.S. DOD Arctic Strategy emphasized that the U.S. must prioritize

⁴⁸⁴ *Statement of General Terrence J. O'Shaughnessy, United States Air Force, Commander, United States Northern Command and North American Aerospace Defense Command: Testimony before the Senate Armed Services Committee*, February 26, 2019, 11.

⁴⁸⁵ "Homeland Defense Academic Symposium," U.S. Northern Command, accessed May 26, 2021, <https://www.northcom.mil/Education/North-American-Defense-and-Security-Academic-Alliance/Homeland-Defense-Academic-Symposium/>

⁴⁸⁶ "Center for Arctic Policy Studies," University of Alaska Fairbanks, accessed May 26, 2021, <https://uaf.edu/caps/resources/insights.php>.

⁴⁸⁷ Michael R. Pompeo, Secretary of State, "Looking North: Sharpening America's Arctic Focus," Arctic Council speech, Rovaniemi, Finland, May 6, 2019 (U.S. Department of State), <https://www.state.gov/looking-north-sharpening-americas-arctic-focus/>.

efforts to address the United States' eroding competitive edge against China and Russia to ensure favorable balances of power in the Indo-Pacific and Europe with the Arctic as the geostrategic crossroad between these regions. A capabilities-based approach to build U.S. allied and partner space collaborative capacity within the Arctic region provides an evolutionary concept that drives operational requirements across the combined allied and partner force. This approach to field capabilities with shared multilateral regional interests can provide a mutually beneficial competitive advantage within the region.⁴⁸⁸ As identified in a recent national intelligence study, "The most powerful actors of the future will be states, groups, and individuals who can leverage material capabilities, relationships, and information in a more rapid, integrated, and adaptive mode than in generations past."⁴⁸⁹ The U.S. and its Arctic allies and partners must seek innovative solutions to build bilateral, interorganizational, and regional space cooperation agreements across their respective civil, commercial, and defense sectors.⁴⁹⁰ The emerging strategic operating environment in the Arctic requires innovative solutions to address the emerging challenges and opportunities.

Protecting U.S. national security interests in the Arctic requires an enduring aerospace and maritime-warning monitoring system that combines additional infrastructure along the U.S. northern border, additional C3ISR assets, improved aerospace early-warning systems, and an enduring maritime domain awareness presence to provide a responsive and resilient deterrent to Russian and Chinese influence within the Arctic. To deter potential peer competitors' influence within the Arctic, the United States must first acknowledge the strategic relevance of space operations to the Arctic region and understand the civil, commercial, and defense space capabilities of U.S. Arctic allies and partners. Arctic awareness is crucial for deterrence, surveillance, and defense of the

⁴⁸⁸ Scott Jasper, "The Capabilities-Based Approach," *Transforming Defense Capabilities* (Boulder: Lynne Rienner Publishers, 2009), 18–19.

⁴⁸⁹ National Intelligence Council, *Global Trends: Paradox of Progress* (Washington, DC: National Intelligence Council, 2017), 28, <https://www.dni.gov/files/documents/nic/GT-Full-Report.pdf>.

⁴⁹⁰ John J. Garstka, "Patterns in Innovation," *Transforming Defense Capabilities* (Boulder: Lynne Rienner Publishers, 2009), 75–76.

homeland as well as power projection to maintain U.S. and partner sovereignty rights. Current strategic initiatives focus on the development of additional C3ISR space-based and terrestrial-based sensors as well as advancements and refurbishment of U.S. and Canada-based missile defense systems.⁴⁹¹ However, these initiatives largely ignore the strategic value of United States partners and allies within the region. The United States must leverage these additional allies and partners to enhance space operations and associated capabilities to increase access to currently denied areas, provide persistent C3ISR coverage, and facilitate collective operational and tactical responses to Arctic operations. These initiatives directly contribute to the defense of the Arctic as part of the United States homeland and are a focused effort to succeed in future polar great power competition within the Arctic.

The United States has ignored the Arctic security environment for too long through underinvestment, leading to degraded facilities and capabilities within the region. The Arctic is the crossroads in this polar great power competition, and the United States must seek a more persistent, responsive, and resilient, allied and partner force to maintain U.S. allied and partner competitive advantages.⁴⁹² In 2019, General David Goldfein, then-Air Force Chief of Staff, stated at the Conference of International Air Chiefs that “we’re far stronger together than we are individually.”⁴⁹³ This is the strategic message the United States must focus on to build space collaborative capacity within the Arctic that leverages U.S. allies and partners, increases U.S. prestige abroad, and deters potential adversaries from hostile military activities against U.S. national strategic interests in the Arctic. The 2011 National Security Space Strategy emphasized, “Active U.S. leadership in space requires a whole-of-government approach that integrates all elements of national power, from technological prowess and industrial capacity to alliance building and diplomatic

⁴⁹¹ *Statement of General Terrence J. O’Shaughnessy, United States Air Force, Commander, United States Northern Command and North American Aerospace Defense Command: Testimony before the Senate Armed Services Committee*, February 26, 2019, 10.

⁴⁹² Department of Defense, *2019 DOD Arctic Strategy*, 2.

⁴⁹³ Erwin, Sandra, “Air Force Chief Goldfein: To Win in Space, U.S. Must Work Closer with Allies,” SpaceNews, last modified April 13, 2019, <https://spacenews.com/air-force-chief-goldfein-to-win-in-space-u-s-must-work-closer-with-allies/>.

engagement.”⁴⁹⁴ This same sentiment must be applied to the Arctic. The time to invest in building space collective action in the Arctic is now.

⁴⁹⁴ Department of Defense, *2011 National Security Space Strategy Unclassified Summary*, 13.

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