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ENSURING SURVIVABILITY FOR NAVAL SPECIAL WARFARE OPERATIONS IN THE ARCTIC

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THESIS

ENSURING SURVIVABILITY FOR NAVAL SPECIAL WARFARE OPERATIONS IN THE ARCTIC

by

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December 2022

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Naval Special Warfare (NSW) operators are not currently manned, trained, or equipped to effectively survive or execute High Arctic mission sets. The dynamic rate of environmental change and the adversarial exploitation of the Arctic regions have disadvantaged the United States and its allies. This capstone intends to reduce inherent survival risks an NSW operator would incur associated with extreme "cold" and increase the duration an NSW operator can remain on station in the High Arctic. The end state is to provide NSW with research and a Course of Action (COA) that leads to prototype production, orchestrated through the Defense Innovation Unit (DIU), enabling NSW operators to rapidly respond to crisis/conflict in all Arctic regions.

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ENSURING SURVIVABILITY FOR NAVAL SPECIAL WARFARE OPERATIONS IN THE ARCTIC

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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

Naval Special Warfare (NSW) operators are not currently manned, trained, or equipped to effectively survive or execute High Arctic mission sets. The dynamic rate of environmental change and the adversarial exploitation of the Arctic regions have disadvantaged the United States and its allies. This capstone intends to reduce inherent survival risks an NSW operator would incur associated with extreme "cold" and increase the duration an NSW operator can remain on station in the High Arctic. The end state is to provide NSW with research and a Course of Action (COA) that leads to prototype production, orchestrated through the Defense Innovation Unit (DIU), enabling NSW operators to rapidly respond to crisis/conflict in all Arctic regions.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAR	After Action Report
ADF	Alaska Defense Force
AOI	Area of Interest (DIU Document)
AOR	Area of Responsibility
COTS	Commercial off the Shelf
CSO	Commercial Solutions Opening
CT	Counter Terrorism
DIU	Defense Innovation Unit
DOD	Department of Defense
EEZ	Economic Exclusive Zone
GWOT	Global War on Terror
IRF	Immediate Response Force
NATO	North Atlantic Treaty Organization
NPS	Naval Postgraduate School
NSR	Northern Sea Route
NSW	Naval Special Warfare
ORM	Operational Risk Management
OT	Other Transaction
OTA	Other Transaction Authority
PCU	Protective Combat Uniform
R&D	Research and Development
RF	Radio Frequency
RFID	radio frequency identification
SEAL	Sea Air Land (NSW operator)
SOF	Special Operations Force
SOFAR	sound fixing and ranging
U.S.	United States

WARCOM	Naval Special Warfare Command

EXECUTIVE SUMMARY

NSW WARCOM Executive Summary

Naval Special Warfare (NSW) operators are not currently manned, trained, or equipped to survive or effectively execute High Arctic mission sets.

Why now? The rapid and dynamic rate of environmental change and the adversarial exploitation in the Arctic regions have positioned the United States and its allies at a disadvantage. The disadvantage NSW has is that operators cannot currently execute required mission sets without inheriting immense risk to the warfighter and the NSW chain of command. The United States has a window of opportunity to resurrect and innovate upon historic Arctic warfare capabilities. However, the window of opportunity could close as the Arctic environment continues to change drastically and adversaries move to expand deterrence capabilities and exploit the Arctic regions.

The Arctic Survivability Package would allow NSW operators immediate access and placement in the Arctic mission set and fill the capability gap for NSW operators to execute mission sets in the polar north successfully.

In preparation for Strategic Deterrence operations with China and Russia in the polar regions, NSW's mission effectiveness and NSW operator survivability are highly limited within Arctic and Antarctic environments due to freezing temperatures (lowest recorded temperature -95°F), additional environmental factors, and Russian air/surface/ sub-surface domain capabilities.

To achieve mission effectiveness as outlined by the 2022 Department of Defense (DOD) Arctic Strategy and the North Atlantic Treaty Organization (NATO) Arctic mission set requirements, NSW must eliminate the inherent risks surrounding operator survivability within the Arctic environment. Simply put, when the NSW operator steps onto the Polar Arctic environment, his primary focus is on survival and not mission execution. Eliminating or mitigating survival as the operator's key concern allows the operator's primary focus to be mission success.

In partnership with the Defense Innovation Unit (DIU), we have scoped the problem set of survivability to offer innovative solutions for the NSW operator in the Arctic. The primary problem we will be solving is reducing inherent risks associated with extreme "cold" and the secondary problem of increasing NSW operator duration in the Arctic Area of Responsibility (AOR).

Proposed Course of Action

The Arctic Survivability Package is a two phased approach to addressing the mobility/duration concern and concern the environment has on NSW operator survival.

Phase 1 (Duration Solution): will present the NSW operator with a mounted Arctic mobility package. Such a package would allow an NSW element to navigate the polar ice cap and Arctic tundra terrain while keeping the operators in a determinable environment. The Arctic mobility package would give the NSW operator two weeks of mission duration. Additionally, the Arctic mobility package would be capable of variable platform Insertion/Extraction. The Arctic mobility package will solve the Arctic mobility problem for the team and individual movement, facilitate ancillary equipment (communications, medical, IRF, organic fires) necessary for mission success, and be a power supply for Phase 2.

Phase 1 Recommendation: The Arctic Survivability Package is currently conceived to consist of three polar outfitted vehicles (recommended: Polar Expedition Toyota Hilux) that support two marsupial snow bikes (recommended: Timbersled) per Hilux.

Phase 2 (Survival): would present the NSW operator with individual heated clothing that could augment the current Protective Combat Uniform (PCU) load out and pair with the mounted Arctic mobility package from Phase 1. Phase 2 will allow the NSW operator 72–96 hours individual duration in the Arctic environment outside the Arctic Survivability Package. The unique heated clothing would add to the current PCU loadout to allow operator familiarity and ease of unit adoption. The heated clothing would receive power from elements of Phase 1 when co-located and power from a self-

contained power unit when not co-located. This technology package would allow NSW operators to focus solely on mission effectiveness instead of simply surviving.

Ancillary areas of consideration within the problem set lie within the domain of operator delivery method. Further prototyping could explore similar capabilities for enhanced operator survivability within the near-surface and sub-surface domains. The package could provide NSW with a modular technology that can integrate into multiple mission sets.

The end state is to provide an NSW element the ability to respond rapidly to Arctic crisis/conflict. By utilizing the DIU's innovation generation and adoption practices, NSW can shape its Arctic Survivability Package, quickly enter the Arctic space, and rapidly adapt to the changing environment and adversarial capabilities. Modernizing NSW's Arctic capabilities would allow the NSW element to "roll up the garage door" and execute missions in an otherwise prohibitively inhospitable environment.

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The research presented is dedicated to NSW Warfighters so that they can fulfill the nation's needs to the best of their abilities. "A pint of sweat will save a gallon of blood." —General George S. Patton

Additionally, I would like to acknowledge the hard work of those that displayed an inspiring joint effort to understand and develop Courses of Action for the NSW Arctic mission set:

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- Cpt. Nate Schimmel
- Saul Fields

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I. INTRODUCTION

A. SCOPE AND TOPIC

In preparation for strategic deterrence operations with China and Russia, NSW (Naval Special Warfare) mission effectiveness and NSW operator survivability are highly limited within the Arctic and Antarctic environments due to freezing temperatures (-95°F) and other Arctic environmental factors.[1] To achieve mission effectiveness, NSW mU.S.t eliminate or highly reduce the inherent risk of operator survivability within the Arctic environment. NSW mU.S.t do this because survival in the High Arctic Region, if not already, will become a viable route of approach for NSW response in crisis events.[2] Extreme cold weather survival is the operator's primary focus when executing missions in the High Arctic, thus making mission effectiveness a secondary focus to the NSW operator. Eliminating or highly reducing survivability will allow for the primary focus of the operator to be on mission effectiveness.

The capacity to survive is highly variable within its own right and varying environments play detrimental roles to survival. For example, the methods of constructing a survival shelter can depend on available resources, weather impacts, time of year, and region of the world where the shelter is required. In the refined region of the Arctic, there is still extreme variability of environment. The Cold War era was relatively constant with little changes throughout the times of year and weather environmentals. Since the U.S. military has been executing its counterterrorism responsibilities, the relative constants of the cold war era Arctic have changed. Climate change (previously termed global warming) is now rapidly affecting the Arctic environment and making that environment highly variable day-to-day. Figure 1 is a graphic representation of Arctic change; it is the daily high Arctic temperatures within the High Arctic, recorded from 1958 to the present day. With such variability in the Arctic region (denoted as the areas

[1] "WMO Recognizes New Arctic Temperature Record of 38^0C," Professional, World Meteorological Organization, December 13, 2021, https://public.wmo.int/en/media/press-release/wmo-recognizes-new-arctic-temperature-record-of-38%E2%81%B0c.

[2] Zachary Labe, "Arctic Temperatures," Professional, *Zachary Labe* (blog), October 3, 2016, https://zacklabe.com/arctic-temperatures/.

above 60 degrees latitude), it became readily apparent that there was a need to understand what modern survival looks like for an NSW operator in the Arctic.

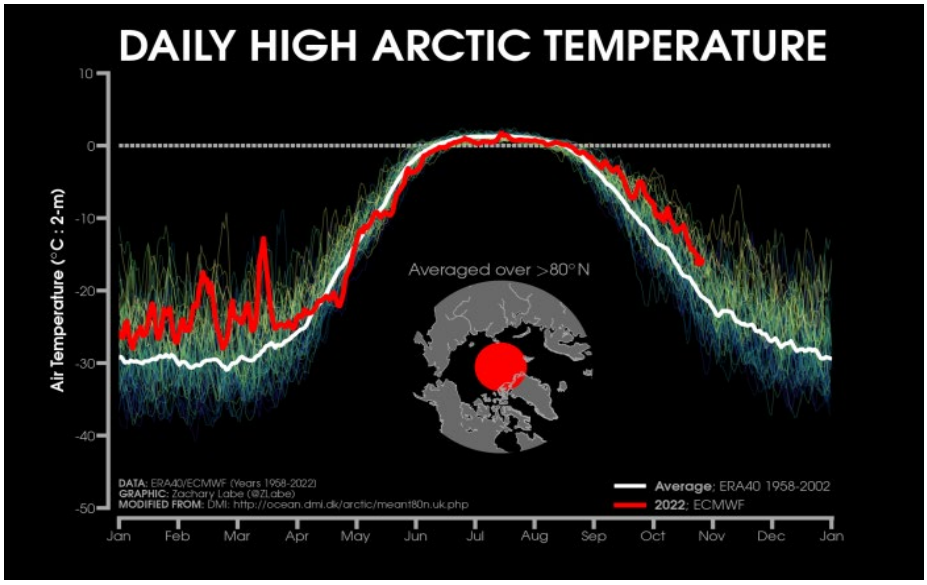

Figure 1. Daily High Arctic Temperatures[3]

To appropriately execute an NSW mission, an NSW operator must be able to gain access and placement to the AOR (Area of Responsibility), conduct their required tasks, and then leave that AOR. From those three subcategories of mission execution, there were two overarching areas that the NSW operator must consider regarding survival in the Arctic. The first is time on station or the duration in which the team and individuals can remain in the AOR to accomplish their mission. The second is the environmental aspects that remove the NSW operators' focus from effectively accomplishing the mission. This is to say that NSW operators must focus on the mission they are executing so that they can rapidly adapt and accommodate the potential variables of warfare. If the environmental aspects of a particular AOR remove that focus of mission accomplishment, then the NSW operator is inherently at a disadvantage. In the case of the Arctic AOR, the disadvantage is being cold, being at a temperature that is uncomfortably

[3] Source: Labe.

low for humans.[4] Extreme cold is the environmental aspect that removes the NSW operator's focus from effectively accomplishing their mission.

To reduce or eliminate the inherent risk an NSW operator has while operating in the Arctic, the scope of NSW survival must be prioritized around the two overarching areas of mission accomplishment. Those two areas are duration in the High Arctic and the subjective perception of 'cold' to the individual operator. Additionally, the scope of NSW survival must be refined to the high Arctic region, commonly understood as the area above the 60th degree of latitude. This region has the highest rate of change regarding environmental factors. If the NSW operator can survive in the high Arctic, then he will be able to adapt to the other five regions of the Arctic readily.

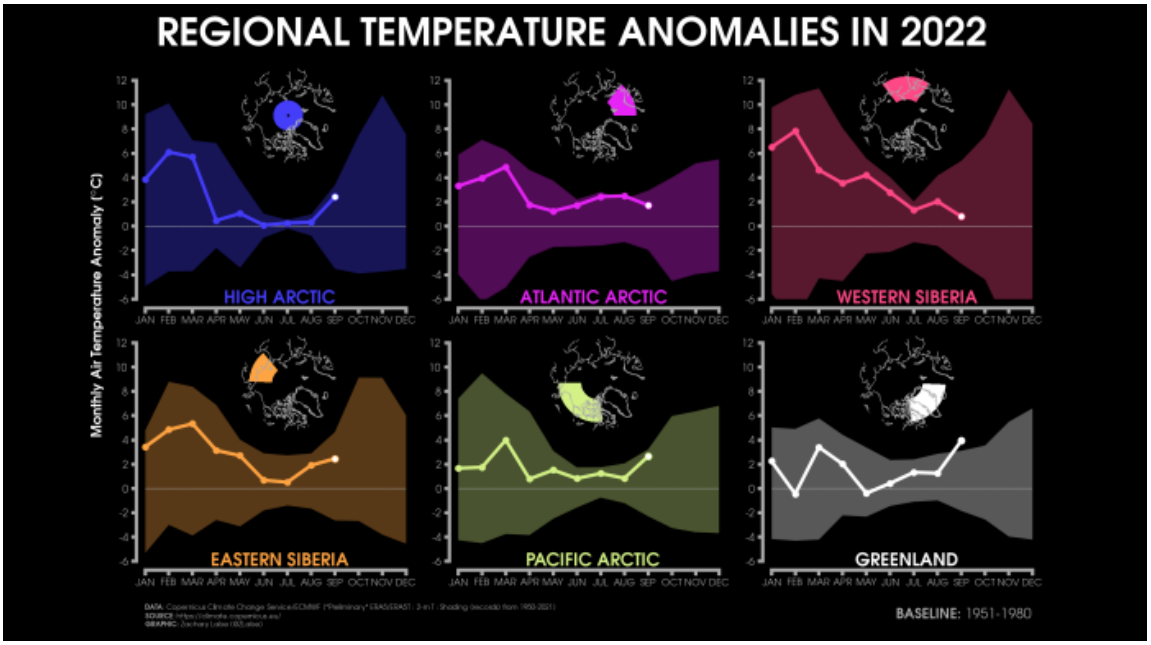

Figure 2. Regions of the Arctic [5]

[4] "Definition of COLD," Unabridged Dictionary, Merriam-Webster, December 8, 2022, https://www.merriam-webster.com/dictionary/cold.

[5] Source: Zachary Labe, "Monthlytanomalies_era5_regions.Png (2700×1500)," Professional, Zachary Labe, 11/1/20222, https://zacklabe.files.wordpress.com/2022/10/monthlytanomalies_era5_regions.png.

B. PROBLEM TO BE SOLVED

1. The Problem Set

Naval Special Warfare cannot currently execute required mission sets without inheriting immense risk to the war fighter and chain of command.

2. The Environmental Problem: Focusing on the Physical/Natural Challenges

a. Cold

The environmentals of the six Arctic regions vary dramatically and vary in ways not yet understood as climate change affects the regions. The High Arctic is the harshest environment of the six regions for human beings, therefore, the harshest to operate in. Because it is the harshest environment to operate in, survival is at the forefront of the operator's mindset. The cold is directly tied to survival because it degrades bodily function and capability, leading to death. Warfare already incurs mortality concerns but layering additional concerns of death due to the environment only increases the probability of death.

Additionally, with climate change considerations, Arctic temperatures have been highly variable, with record-setting highs and lows. These varying temperatures pose significant concerns for the NSW operator because gear selection is fundamental to mission planning and execution. If NSW can reduce the environmental risk of death, like they have in desert and jungle environments, then Arctic operations become more accessible.

b. Terrain and Mobility Considerations

The terrain styles vary daily, monthly, and yearly. The terrain can be jagged, laced with crevices that can only be seen when close to them, rapid elevation changes, and varying types of terrain. The terrain affects the mobility platforms during insertion and extraction and affects infiltration and exfiltration. Dependent on the terrain, the NSW unit could have to consider navigation contingencies, possibly mission abort. The terrain affects mission planning, route development, and time and distance calculations. Because

climate change is dramatically affecting the terrain, a versatile mobility platform or platforms must be considered.

Figure 3. High Arctic Terrain[6]

c. Communications

The electromagnetism of the High Arctic affects compasses and communications, making navigation and communications a challenge (Figure 4). Multiple spectrums of Radio Frequency (RF) energy are affected by the electromagnetism, the raw materials under the polar north ice cap and the earth's polarization. The electromagnetism impacts traditional compasses, making traditional navigation a near impossible. Specialized navigation and communications equipment are required because of the electromagnetic capacities within the Arctic environment.

[6]Source: Mario Tama, "NASA Flyover Reveals Arctic Ice in Retreat," NBC News, NBC News, April 6, 2017, https://www.nbcnews.com/slideshow/nasa-flyover-reveals-arctic-ice-retreat-n742596.

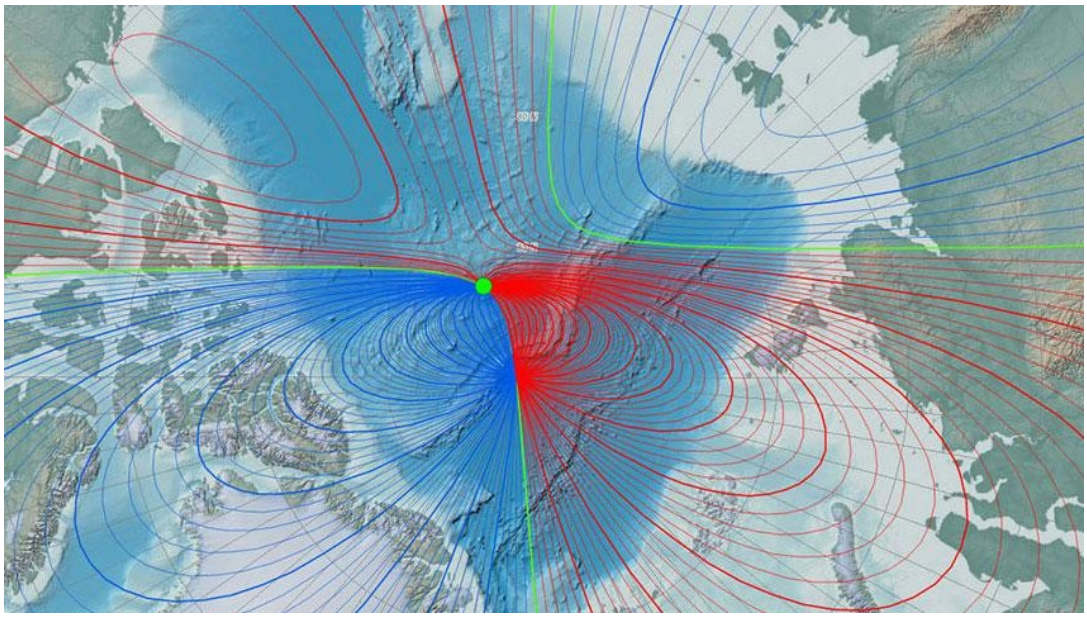

Figure 4. Magnetic Fields of the Arctic[7]

The atmospheric weather conditions also drastically affect the Arctic environment by generating winter storms, changes in wind, and changes in temperature.[8] Water conditions also highly affect the NSW operator. These environmentals vary drastically depending on the time of day and must be taken into account whenever an NSW operator is needed to execute a mission. Because the NSW operator can not necessarily always choose when they must execute a mission, they must be able to execute the mission in all conditions. The problem with the Arctic is that to be able to operate in any of the High Arctic environmentals, the NSW operator must first be able to survive. Then they must have survival as a secondary focus in their mindset to be able achieve mission success.

The environmental factors are a significant factor for the DOD and the allies of the United States. They also play a significant factor in adversarial accessibility. While electromagnetic, climate change and variable temperatures are limited to the United States, these factors have been welcomed by the Russians and the Chinese. The Russians

[7]Source: "Earth's North Magnetic Pole Is Heading for Russia," News, The Independent Barents Observer, November 2, 2022, https://thebarentsobserver.com/en/arctic/2019/12/earths-north-magnetic-pole-heading-russia.

[8] "WMO Recognizes New Arctic Temperature Record of 38^{0}C."

welcome climate change because they can access most of the previously frozen Tundra in Siberia. The Chinese like climate change because they can access more resources.

C. RIVAL ACTORS' CAPABILITIES AND STRATEGIES

Other State actors are aggressively expanding the defensive capabilities into the Arctic. An aspect of the military capabilities are the early detection assets installed and the kinetic kill options installed. The early warning and detection devices range throughout many mediums and domains. There are acoustic detection devices for the sub-surface domain.[9]

Russians have installed radar installations that can track the most recent allied Joint Strike Fighters, in the air domain.[10] There are also seismic and RFID/SOFAR radars that can detect vehicles and troops in the land/ice domain.[11] The deterrence possibilities for Russia in the Arctic and along the NSR (Northern Sea Route) have been invested in heavily and can be seen in Figure 5 and Figure 6. Figure 5 depicts the early detection zones and kinetic kill zones for five of the seven Russian military bases online in 2013. While Figure 6 shows how the Russian military has expanded their coverage and bases to 25 in just 8 years.

[9] "New Acoustic Detection System to Make Russian Navy's 4th-Gen Stealth Subs Even Quieter," Blog, RT International, July 6, 2015, https://www.rt.com/news/271888-russian-stealth-submarine-signature/.

[10] Ashish Dangwal, "Stealth Killer! Russia's Rezonans-NE Radar That Can Track F-35 Jets Deep Inside Finland & Norway Begins Construction — Reports," News, Latest Asian, Middle-East, EurAsian, Indian News, June 30, 2022, https://eurasiantimes.com/stealth-killer-russias-rezonans-ne-radar-that-can-track-f-35-jets-russia/.

[11] "NTC VISMOD KREDO-M1 Russian Target Detection Radar - WEG MediaWiki," Government, NTC VISMOD KREDO-M1 Russian Target Detection Radar, November 1, 2022, https://odin.tradoc.army.mil/mediawiki/index.php/NTC_VISMOD_KREDO-M1_Russian_Target_Detection_Radar.

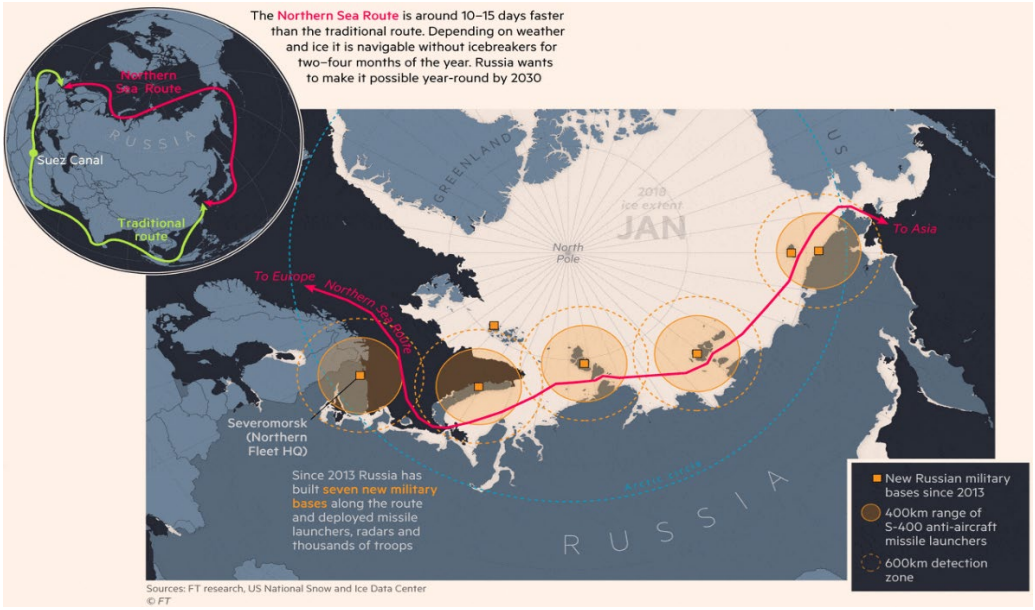

Figure 5. Russian Military Bases 2013[12]

Figure 6. Russian Military Installations along NSR[13]

[12] Source: Financial Times [@financialtimes], "Russia Is Spending Billions to Assert Control over a Vital Shipping Route in the Arctic. It's Much Faster than the Traditional Route, and with the Hydrocarbon Reserves That Lie beneath It, the Northern Sea Route Is a Goldmine for Global Powers: Https://On.Ft.Com/2GFOncM Https://T.Co/P8AKA4DC3W," Tweet, *Twitter*, May 1, 2019, https://twitter.com/financialtimes/status/1123512417093345281.

China has also begun to rapidly invest in the economic potential of the Arctic and potentially installing military presence in the Arctic. China has termed itself a near-polar power to allow itself access to the Arctic region.[14] Their published 2018 Arctic Strategy states that the Chinese State has a vested interest in protecting Arctic wildlife, protecting the international waters of the Arctic, protecting the shipping routes (Northeastern Passage, Northwestern Passage, and Polar Passage), and to protect but use the natural resources of the Arctic.[15] The Chinese protection of the Arctic, Polar Silk Road Initiative, is a part of their greater One Belt One Road Initiative. These initiatives and their vague definition of 'protection' will likely have some sort of military element involved.

Higher classifications are able to provide more clarity for the intricacies of adversarial competition in the Arctic. However, Section C is meant to quickly explain the overt display of adversarial advancements in the Arctic. These overt advancements drive a necessary concern for NSW to operate in the Arctic.

1. NSW COMMUNITY CONCERN

Naval Special Warfare is not adequately manned, trained, or equipped to execute its prescribed mission sets in the Arctic.

The prior Counter Terrorism (CT) mission requirements took primacy over other mission areas to win the Global War on Terror (GWOT). The Arctic regions were one of the ancillary mission areas that were relegated. The relegation of the Arctic Warfare mission set was natural because CT was the nation's need for 20 years. The recent shift from CT to Strategic Deterrence has re-incorporated various warfare areas such as Jungle, Arctic, and Southern Pacific.

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[13] Source: Melissa Rossi, "Russian Military Moves in the Arctic Worry the U.S. and NATO," News, Yahoo!news, June 10, 2022, https://news.yahoo.com/russian-military-moves-in-the-arctic-worry-the-us-and-nato-090027224.html.

[14] Swee Lean Collin Koh, "China's Strategic Interest in the Arctic Goes beyond Economics," News, Defense News, May 12, 2020, https://www.defensenews.com/opinion/commentary/2020/05/11/chinas-strategic-interest-in-the-arctic-goes-beyond-economics/.

[15] Xinhua, "Full Text: China's Arctic Policy," Government, The State Council The People's Republic of China, January 26, 2018, http://english.www.gov.cn/archive/white_paper/2018/01/26/content_281476026660336.htm.

Additionally, the 'wicked problem'[16] of climate change has rapidly and dynamically affected the Arctic regions, demanding the Department of Defense's attention. The dynamic climate change in the Arctic is a wicked problem because there is no linear path of solutions, and no one solution will solve the effects of climate change.[17] For NSW dominance in Arctic warfare, solutions must be formulated and adopted into practice across a spectrum of Arctic warfare operations. Such operations include advancements in doctrine, policy, human systems, communications, mobility platforms, human systems, weaponry, and logistics. While no one innovation adoption will solve the Arctic climate change wicked problem, the adoption of an advanced survivability system for the NSW operator will allow NSW to understand the wicked problem more fully and rapidly adapt for dominance.[18]

D. SIGNIFICANCE

As the economic interests of the United States grow so too does the need to protect those interests and the rights of her citizens while trying to achieve those interests. Therefore, the United States military must care how America's interests grow specifically towards the Arctic. The United States Navy is anticipating the Arctic Ocean to become more available as climate change occurs and allows for economic advances into the northern region. It is so impactful to the United States Navy that they published a strategic document called Blue Arctic. Blue Arctic displays concern for militaries in the Arctic and potential paths to take in defending American interests in the region.[19] The Blue Arctic is a blueprint for how the United States Navy and United States Marine Corps should address the likelihood of a navigable Arctic and even iceless Arctic. This

16 Horst Rittel and Melvin Webber, "Wayback Machine," Internet Archive, Wayback Machine, September 30, 2007, https://web.archive.org/web/20070930021510/http:/www.uctc.net/mwebber/Rittel+Webber+Dilemmas+General_Theory_of_Planning.pdf.

17 Rittel and Webber.

18 Rittel and Webber.

19 "Department of the Navy Releases Strategic Blueprint for a Blue Arctic," Government, United States Navy, November 2, 2022, https://www.navy.mil/Press-Office/Press-Releases/display-pressreleases/Article/2463000/department-of-the-navy-releases-strategic-blueprint-for-a-blue-arctic/https%3A%2F%2Fwww.navy.mil%2FPress-Office%2FPress-Releases%2Fdisplay-pressreleases%2FArticle%2F2463000%2Fdepartment-of-the-navy-releases-strategic-blueprint-for-a-blue-arctic%2F.

blueprint was generated on behalf of the Secretary of the Navy, the Chief of Naval Operations, and the Commandant of the Marine Corps. With the assessment that the Arctic will be iceless in the next two decades, the need for capable naval forces to protect America's interests and people remain in the forefront in military leader's minds.[20]

As a subcommunity within the United States Navy, Naval Special Warfare must also inherently protect the interests and American people within the Arctic region. To meet the Arctic strategy laid out by United States Naval leaders, Naval Special Warfare must be able to execute its required mission sets and accomplish those mission sets with success. These are technically two different notions that must be acted upon. Firstly, Naval Special Warfare must be able to execute its mission sets. This inherently means being manned, trained, and equipped prior to even 'stepping out of the door' to begin the mission. Secondly, Naval Special Warfare must have a likely measure of accomplishment to achieve mission success. Mission success is variable to the commander of the mission and to the personnel executing the mission however, there are pre-mission Operational Risk Management (ORM) measures and After Action debriefs/Reports (AAR) that allow for measure of mission success. With the Arctic region relegated, in the previous years, to the Counter Terrorism (CT) warfare construct, Naval Special Warfare will have to re-enter the Arctic warfare realm to protect the interests of the United States Navy and the United States of America.

E. LITERATURE REVIEW

1. THE ARCTIC: The Next "Cold War"?

As our climate shifts and the North Pole heats up, so too does the competition, between nations, for the Arctic's untapped resources. The Arctic has vast quantities of resources under its polar ice cap, such as highly populated fishing grounds, Arctic oil and gas, minerals, and aggregates.[21] Many nations, including self-proclaimed near-Arctic nations, are competing for access to these resources. With economic competition also

[20] "Press-Release Navy Arctic Strategy."

[21] Arctic Natural Resources. National Ocean Economics Program. https://www.oceaneconomics.org/Arctic/NaturalResources/

comes preparation for potential military operations within the Arctic. With the growing economic and militaristic competition heating up, will the United States of America be left on a proverbial ice flow drifting away from the advancing competition? The United States military, for some time now, has been postulating it role and ability to operate within the Arctic domains. Yet, has postulation been the only action taken by strategists and military leaders?

To understand if the United States has comprehended the Arctic problem set and applied itself militarily and economically to the problem solving of potential operations within the Arctic, I selected two documents produced, by the U.S. military, that assess the conditions and the U.S. strategic plan for the Arctic end state. These documents attempt to understand and postulate the United States military's role within the Arctic. Additionally, the two documents were produced nine years apart. Analysis of the two documents can determine the progress made, or not made, in the Arctic. Upon review of these two documents, we understand whether the U.S. military has made progress in tackling the Arctic problem set.

The first document, *The Arctic: A New Paradigm or the Next "Cold War"?* is an assessment of the U.S. military preparation for Arctic operations, Arctic conditions, and recommendations for how the U.S. military should proceed in tackling the Arctic problem set. In 2010, the Joint Military Operation Department, produced this document to advise politicians and military leaders of the rapidly changing Arctic environment due to climate change.[22] It also advised how the Joint Military Operations Department understood the United States to be significantly behind other nations that are competing within the Arctic. A significant amount of this document focused on climate change melting the Arctic ice caps, thusly exposing raw minerals, and making the Northeast Passage increasingly accessible.[23] Additionally, the report also details possible territorial expansion as the ice caps melt past the national Economic Exclusive Zones (EEZ) and into the international Arctic ice mass. The most poignant argument the Joint Military

[22] Joint Military Operations Department, The Arctic: A New Paradigm or the Next "Cold War"?, (Monee IL: 2010), 1–24.

[23] Joint Military Operations Department, The Arctic: A New Paradigm or the Next "Cold War"?

Operations Department makes, within the document, is that the United States is drastically behind the 'Arctic power curve' as compared to other Arctic nations, specifically Russia.[24] The Joint Military Operation Department recommended it vitally important for the United States to "exercise a more active and leading role in Arctic policy shaping and to demonstrate credibility to act within the international legal system."[25]

The second document is the *June 2019 Report to Congress: Department of Defense Arctic Strategy.* Produced by the Office of the Under Secretary of Defense for Policy, this report updates the previous *2016 Report to Congress: Department of Defense Arctic Strategy.* It outlines the DOD's desired end state for the Arctic, to include three strategic ways to support the United States of America's Arctic end state.[26] In the Report to Congress, the DOD assessed the Arctic Security Environment specifically noting, "The Arctic security environment is complex. Many positive, cooperative trends endure in the region. At the same time, the region is increasingly uncertain, with a deepening and intensifying of certain problematic strategic trends. Although the immediate prospect of conflict in the Arctic is low, these trends could adversely affect U.S. national security interests, promote instability, and ultimately degrade security in the region."[27] The report concluded that key dynamics are affecting the increased economic and militaristic competition at hastening rate. These key dynamics include changing physical environment, multilateral cooperation to address shared interests and challenges, status of Arctic Sea Routes, increasing military activity, and attempts to alter Arctic governance through economic leverage.[28] The assessment of the Arctic security environment, through the key dynamics, show that the United States remains behind the other Arctic nations in the Arctic competition. The DOD recommended three courses of action to be

[24] Joint Military Operations Department, The Arctic: A New Paradigm or the Next "Cold War"?

[25] Joint Military Operations Department, The Arctic: A New Paradigm or the Next "Cold War"?

[26] Office of the Under Secretary of Defense for Policy. 2019, Report to Congress: Department of Defense Arctic Strategy. 19.

[27] Office of the Under Secretary of Defense for Policy. 2019, Report to Congress: Department of Defense Arctic Strategy

[28] Office of the Under Secretary of Defense for Policy. 2019, Report to Congress: Department of Defense Arctic Strategy

more involved in the Arctic's regional issues: build Arctic awareness, enhance Arctic operations and strengthen the rules-based order in the Arctic.[29]

After review, both documents provide an encompassing and factual assessment of the Arctic and its security environment to the United States. Over nine years however, has the United States made significant forward progress in tackling the Arctic problem set? I do not believe the U.S. strategy has shown evolutionary and positive growth over the nine years between the two reports being published. Thusly, Arctic strategy has remained stagnant for nearly a decade. The findings and recommendations from the Joint Military Operations Department were not properly utilized because the 2019 Report to Congress maintains the same findings and recommendations since the Joint Military Operations Department concluded its study nine years prior.

2. The Origins of the Protective Combat Uniform Concept

The GWOT was conducted over multiple continents and primarily three countries. For approximately twenty years the GWOT was fought in Afghanistan, Iraq, and Somalia. To someone not living in these countries it may appear to be strictly desert countries, countries that are hot during the day and, at times, cold at night. However, the temperature differential and diverse environment, in Afghanistan alone, would prove that person wrong. The initial Special Operation Forces (SOF) on the ground had to rapidly adapt to the environment. Afghanistan contains ten mountains over 22,000 feet, its highest mountain being Noshaq (24,580ft/7,492m), and Afghanistan's lowest point is Amu Darya at Khamyab (846ft/258m).[30] The elevation delta is of great importance because, due to operational locations within Afghanistan, SOF operators would have to navigate the entire range of altitudinal zonation. Altitudinal zonation, according to the Oxford Dictionary is: "The pattern of variation of plant and animal species relative to elevation, in response to vertical differences in climate (particularly temperature and

[29] Office of the Under Secretary of Defense for Policy. 2019, Report to Congress: Department of Defense Arctic Strategy

[30] Benjamin, Sawe, "The Tallest Mountains In Afghanistan," World Atlas, 10SEP2019, https://www.worldatlas.com/articles/highest-mountains-in-afghanistan.html.

precipitation)."[31] This meant that SOF operators, within a number of hours (if not minutes, dependent on method of transportation), could be operating in the foothills environment zone (lowest altitudinal zonation sub-classification) then the high-alpine zone; possibly the nival zonation (highest altitudinal zonation sub-classification).[32] The rapid traverse of altitudinal zonation as well as weather patterns forced the SOF community, in 2002, to adapt and adopt the Protective Combat Uniform (PCU).[33]

In 2002, Rick Elder (of the Special Projects Team at the Natick Soldier Systems Center) received a satellite call from U.S. Army Master Sergeant Tony "Bucket" Pryor, who was operating in the Hindu Kush mountains, demanding Elder to develop a better clothing system for SOF operators to remain warm and enhance survivability in that environment.[34] Rick Elder, along with NSW's Cold Weather Center Detachment, created a team with material scientists and extensive cold weather experience experts to prototype and develop an interchangeable combat clothing system. This system came into fruition a year after the team's assembly and is known as the PCU.[35]

The PCU system is compartmentalized into nine distinct levels that would be interchangeable based on the operator's need as they traversed various atmospheric and environmental conditions. Together, the PCU system is comprised of eighteen distinct garments that are complementary of each other.[36] The PCU system was created to provide the operator warming capabilities for both static and kinetic situations. Kinetic situations are when the operator is actively moving or likely in combat. Static situations

[31]"Altitudinal Zonation," Oxford Reference, 2022, https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095406213.

[32]Valenti Rull and Teresa Vegas-Vilarrubia, "Conifer Forest Dynamics in the Iberian Pyrenees during the Middle Ages," Botanic Institute of Barcelona, 01DEC2021, https://www.mdpi.com/1999-4907/12/12/1685/htm.

[33]"The PCU Protective Combat Uniform: A Buyer's Guide and Clothing System History," Imminent Threat Solutions, 30AUG2016, https://www.itstactical.com/gearcom/apparel/comprehensive-guide-protective-combat-uniform/.

[34]Imminent Threat Solutions, "The PCU Protective Combat Uniform: A Buyer's Guide and Clothing System History."

[35]Imminent Threat Solutions, "The PCU Protective Combat Uniform: A Buyer's Guide and Clothing System History."

[36]Imminent Threat Solutions, "The PCU Protective Combat Uniform: A Buyer's Guide and Clothing System History."

are periods of time when the operator is not active or has to remain near-motionless for an extended period of time.[37] The PCU system is adjusted by the operator through adding or removing leveled garments to the system they began with.[38] The purpose of the PCU system is to stabilize body temperature through breathability and expanded functionality of the system.[39]

To understand why the PCU system is so effective at maintaining survivability, four of the five categories of heat loss must be analyzed. The first method by which the human body loses heat is evaporation. Evaporative heat loss is when the body creates sweat due an increased level of activity and the evaporation of the sweat into vapor causes a cooling effect or loss of heat.[40] The second method of how the body removes heat is by convection. Convection heat loss occurs when environmental mediums, such as air or water, flow (move) across exposed skin. The transfer of a higher heat from the body to the environmental medium is convectional heat loss.[41] The third method of heat loss to the body is by conduction. Conduction heat loss occurs when the body transfers heat to a 'cooler' solid, such as an operator sitting on the ground.[42] The fourth method is radiation heat loss. This method occurs when the ambient outside temperature is less than that of the body temperature therefore, losing heat directly to the ambient environment through electromagnetic radiation.[43] The fifth and final method of heat loss is through respiration. From breathing the body expels heat.[44] While there are five ways the human body experiences heat loss, only evaporation, convection, conduction, and radiation heat

[37]Imminent Threat Solutions, "The PCU Protective Combat Uniform: A Buyer's Guide and Clothing System History."

[38]"PCU BLOCK 2 (II). New U.S.SOCOM clothing concept," Punisher, 29APR2020, https://punisher.com.ua/en/pcu-block-2-ii.-novyy-kontsept-odezhdy-U.S.socom./.

[39]Imminent Threat Solutions, "The PCU Protective Combat Uniform: A Buyer's Guide and Clothing System History."

[40]Kevin, Sirmons, "Top 5 ways body heat is lost," CentraCare, 14JAN2016, https://www.centracare.com/blog/2016/january/top-5-ways-body-heat-is-lost/.

[41]Sirmons, "Top 5 ways body heat is lost."

[42]"Heat Loss," ScienceDirect, 2022, https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/heat-loss.

[43]ScienceDirect. "Heat Loss."

[44]Sirmons, "Top 5 ways body heat is lost."

losses apply to the PCU system. Previous cold weather clothing systems consisted of removing saturated layers and adding dry insulation. The PCU system applies insulation as the outermost layer allowing the moisture to move away from the body, and limiting the four methods of heat loss, instead of attempting to keep water out of the PCU system.

a. Existing Technologies

Heated clothing has evolved exponentially since its beginnings in the French military during the first World War. Nicknamed the 'Electric Suits,' the historic electrically heated flight suits were a revolutionary idea however, technologically they lacked the durability for extended combat missions.[45] Modern heated clothing was developed in the 1970s by Gordon Gerbing, an aeronautics machine shop employee, that took note of how cold his fellow employees were after riding their motorcycles into work. He prototyped a heated jacket by deconstructing an electrically heated blanket and reconstructing it into a jacket.[46] With the original heated motorcycle jackets needing to by connected directly to a power source, it has not been until the last decade (2012) that technology and material sciences have allowed heated clothing to become self-reliant.[47] The COVID-19 pandemic has also increased the public appetite for heated clothing due to the world's populace exploring nature and the outdoors so as to not remain secluded, as indoor environments were regulated for pandemic concerns. Wired describes this appetite for the outdoors by analyzing Warming Store's sales and website traffic being both up 200 to 300 percent.[48]

One of the foremost apparel brands within the heated clothing market is ActionHeat. ActionHeat is utilizing cutting edge material sciences as well as battery and infrared modern technologies to heat their various garments.[49] They utilize a universal USB 5V battery technology, to heat their garments and power ancillary equipment, such

[45]Kate, Knibbs, "My Quest to Survive Quarantine—in Heated Clothes," Wired, 12JAN2021, https://www.wired.com/story/cold-wfh-heated-clothes/.

[46]Knibbs, "My Quest to Survive Quarantine—in Heated Clothes."

[47]Knibbs, "My Quest to Survive Quarantine—in Heated Clothes."

[48]Knibbs, "My Quest to Survive Quarantine—in Heated Clothes."

[49]"About ActionHeat, Who we are," ActionHeat, 2020, https://actionheat.com/pages/about-U.S.-1.

as a cell phone. Their garments apply FAR-infrared heating and ActionHeat reflective technology to their carbon fiber and metal built-in heating panels allowing the garments to be lightweight, modular, while providing sustained comfort to the wearer.[50] Currently, ActionHeat heated garments can heat the user for approximately four hours.[51] While ActionHeat currently markets to the skier, hunter, dog walker, and outdoorsman, it remains a relatively new technology and begs the question of whether their technology could be used to augment a SOF operator and their mission sets.

b. Gaps in Technology—Can Heated Clothing be Applied to SOF

As the United States of America concludes the GWOT and moves to a cold war style of warfare preparation, Strategic Deterrence, previously uninhabitable environmental domains are opening. Specifically, the Arctic is becoming more likely to be the next possible area of strategic concern. As climate change is becoming more recognizable and data analytics are readily available, powerful nations are beginning to race for domination of the international resources the Arctic has to offer. For example, "The Northern Sea Route is one of Russian President Vladimir Putin's flagship projects and he recently said that the country is aiming for year-round sailing along this shipping lane."[52] It is likely that as trade increases through the Arctic region and raw minerals are exposed for mining that the Arctic region will be of great concern for SOF.

The most obvious gap in current technology is SOF's current PCU system only functioning to -50°F yet, the coldest recorded temperature in the Arctic was -93.3°F. The coldest recorded temperature was recorded on 12 December 1991 and not at the coldest possible point in the Arctic but at Klinck AWS in Greenland (within the Arctic circle).[53] As the potential for conflict increases in the Arctic, SOF operators need to be able to fight

[50] ActionHeat, "About ActionHeat, Who we are."

[51] ActionHeat, "About ActionHeat, Who we are."

[52] Peter Danilov, "India Wants to Help Russia Develop Northern Sea Route Into International Trade Artery," High North News, 2021, https://www.highnorthnews.com/en/india-wants-help-rU.S.sia-develop-northern-sea-route-international-trade-artery.

[53] "WMO recognizes new Arctic temperature record of 38ºC," World Meteorological Organization, 14DEC2021, https://public.wmo.int/en/media/press-release/wmo-recognizes-new-Arctic-temperature-record-of-38%E2%81%B0c.

effectively and survive in the environment where it is possible the temperature could be -93.3°F.

An additional gap is the duration and reliability of heated clothing within the military construct. Current technology does not offer heating of the clothing past four hours unless there are multiple power sources.[54] For a SOF operator executing a mission over multiple days, even weeks, four hours of supplied heat is not enough to sustain SOF survival at low temperatures. The present clothing is also not marketed for the reliability of maintaining its heating capability during combat operations. This inherently is a problem for SOF operators that will likely be engaging in combat operations.

While these gaps are pervasive, further research into heated clothing for the SOF operator will allow for increased operator survivability and mission effectiveness. Research into this area will also solve potential future gaps such as:

- Be available to Joint SOF services and (eventually) conventional services,
- Be worn under thermal signature defeating uniforms allowing the operator to remain warm while displaying minimal thermal signature
- Be worn in conjunction with thermal blanket for hypothermia deterrence for casualties (medical application)
- Allows forces to rapidly adapt to all worldly environments
- Decreases amount of necessary survival gear
- Increases operator mobility during combat actions (due to less gear on the operator and less carried in ruck)
- Decreases operator profile signature within environment
- Variable temperature settings increase operator survivability and comfortability

[54]Action Heat, "About ActionHeat, Who we are."

3. Leveraging Commercial Off the Shelf Technology

To the Department of Defense, Commercial Off the Shelf (COTS) references mature and relatively cost-effective products that can be implemented into service. COTS technologies and equipment are mature because companies have already entered the commercial marketplace and have seen relative success with that technology or equipment. The DOD must utilize mature technologies and equipment from the commercial sector because it means the DOD does not have to invest in Research and Development (R&D) in order to solve problems. Because the DOD does not need to invest in a complete project creation life cycle, the DOD can invest the money that would have been allocated to an entire creation life cycle to other needs.

New Zealand is currently utilizing COTS communication technologies to rapidly provide its military with mature capabilities over the next decade.[55] New Zealand is buying COTS solutions to be a quick follower instead of directly investing in expensive entire project creation life cycles.[56]

In April 2015, the Department of Defense saw to leverage commercial technology to assist war fighters.[57] To work "at the speed of business," Defense Secretary Ash Carter announced the creation of the Defense Innovation Unit Experimental (DIUx). The creation of DIUx sought to effectively identify new and mature technologies that could rapidly be put in the hands of the warfighter.[58] The DIUx would utilize Other Transactional Authorities (OTA) outside the current DOD acquisition program to access commercial technology earlier than the DOD normally would. Defense Secretary Carter

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[55] Lee Ferran, "New Zealand's Half-Billion Dollar Bet on COTS to Network Its Army," News, *Breaking Defense* (blog), December 1, 2022, https://breakingdefense.sites.breakingmedia.com/2022/12/new-zealands-half-billion-dollar-bet-on-cots-to-network-its-army/.

[56] Ferran.

[57] "DIUx Official: Working At 'Speed of Business' to Bring Tech to Warfighters," Government, U.S. Department of Defense, December 1, 2022, https://www.defense.gov/News/News-Stories/Article/Article/973315/diux-official-working-at-speed-of-business-to-bring-tech-to-warfighters/https%3A%2F%2Fwww.defense.gov%2FNews%2FNews-Stories%2FArticle%2FArticle%2F973315%2Fdiux-official-working-at-speed-of-business-to-bring-tech-to-warfighters%2F.

[58] "DIUx Official."

stated, "The CSO facilitates fast, flexible, and collaborative work between DOD and technology companies that traditionally have not done business with the department."[59]

a. Commercial Mobility

A specific example of COTS of technology that is mature yet primed for DOD use is the Toyota Hilux polar expedition. In 2011 Toyota's racing development set a Guinness World Record for the fastest overland journey to the South Pole.[60] The highly specialized vehicle for this event is known as the Polar Expedition Toyota Hilux. This specific pickup truck traveled 700 miles in one day, 15 hours, and 54 minutes.[61] Not only is this impressive due to the time-distance calculations necessary, but it is also impressive because of the terrain and climate the vehicle had to navigate.

This feat matters to the DOD because there is already a mature technology available to NSW warfighters with very little adaptation required. It is also vital to the NSW because most of its warfighters are familiar with driving pickup trucks. While there may be climatization requirements, the ability for NSW warfighters to rapidly adopt this mobility platform is relatively easy. If the NSW operator already knows how to drive a truck but must learn how to navigate different terrain styles in the exact vehicle they drive to work, the adoption rate is faster.

b. Commercial heated clothing

The equivalent of commercial heated clothing to that of commercial mobility with the polar expedition Toyota Hilux is ActionHeat, based in Philadelphia. ActionHeat is utilizing cutting edge material sciences, battery, infrared reflective technologies to heat their various garments. And power ancillary equipment[62] Their technological innovations

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[59] "DIUx Official."

[60] Gabriel Brindusescu, "Toyota Tacoma Polar Expedition Truck Goes Under the Hammer Again," Blog, autoevolution, December 31, 2014, https://www.autoevolution.com/news/toyota-tacoma-polar-expedition-truck-goes-under-the-hammer-again-90548.html.

[61] Brindusescu.

[62] "About ActionHeat, Who we are," ActionHeat, 2020, https://actionheat.com/pages/about-U.S.-1.

allowing the garments to be lightweight, modular, while providing sustained comfort to the wearer.[63]

The capability to manipulate heat for the NSW warfighter would greatly enhance survival in the High Arctic. While there may have to be adaptation required for the power source of the heated clothing, the ability for the operator to modulate their heat is necessary. While every individual has their own needs and preferences, a heated clothing layer paired with the current PCU system allows the operator to adjust the overall clothing system to their needs. Doing so gives the NSW operator the knowledge that they have a variable, modular, and redundant survival system. The redundant survival capability returns their focus to mission effectiveness.

[63] ActionHeat, "About ActionHeat, Who we are."

II. PARTNERSHIP WITH DIU

I have partnered with the Defense Innovation Unit (DIU) to scope the problem set and produce a disruptive innovation for the Arctic NSW operator. The primary problem we will be solving is NSW survivability in the High Arctic. We will reduce the risk of "cold" and increase the duration in the Area of Responsibility (AOR) for the NSW operator. This disruptive innovation will allow NSW operators to focus solely on mission effectiveness and accomplishments instead of just trying to stay alive.

Ancillary areas of consideration within the problem set lie within the domain of operator delivery method. As the team began scoping the problem set, we discussed whether to solve operator survivability within the sub-surface or surface domains. The team focused on solving the surface problem set first. Once the team solved the surface problem, the team thought it would be easier to adapt the surface innovation to NSW Arctic combat swimmer duration, as a follow-on adaptation. Additionally, the improvement of operator delivery from a surface naval vessel and other Arctic terrain vehicles could be adapted once the survival package, specifically the heating system and power supply, were developed. Focusing operator Arctic survivability to the surface domain (while still leaving options for achievement within the sub-surface domain) will increase the rate at which this wicked problem is solved, innovated upon, and put in the hands of the operator to accomplish their mission.

A. WHY DIU

The DIU is an organization that brings the Department of Defense ideas from private industry that are oriented to the intermediate future. The intermediate future is ranged from what is possible in two to five years. This allows the DIU to focus on ideas that have a near relevance so that other national laboratories can focus on future warfare ideas that are further in the future than five years.

Furthermore, the DIU utilizes a lean innovation adoption process that can give the DOD the ability to rapidly prototype projects. It also takes advantage of the private industries that, through venture capitalism, have more liquidity than classical defense

spending budgets are used to. Figure 7 displays two graphical representations of where the actual R&D resourcing is located within the U.S. economy.[64] The private industry outspends the federal government, and the defense primes by 91.2%.[65] The federal government purchases its defense products mainly through the defense primes. However, in a competitive marketplace, the recent best ideas follow the money. The money and ideas are in private industry, and the DOD cannot access those resources. The DIU can access private industry to obtain new and innovative ways for solving DOD problems.

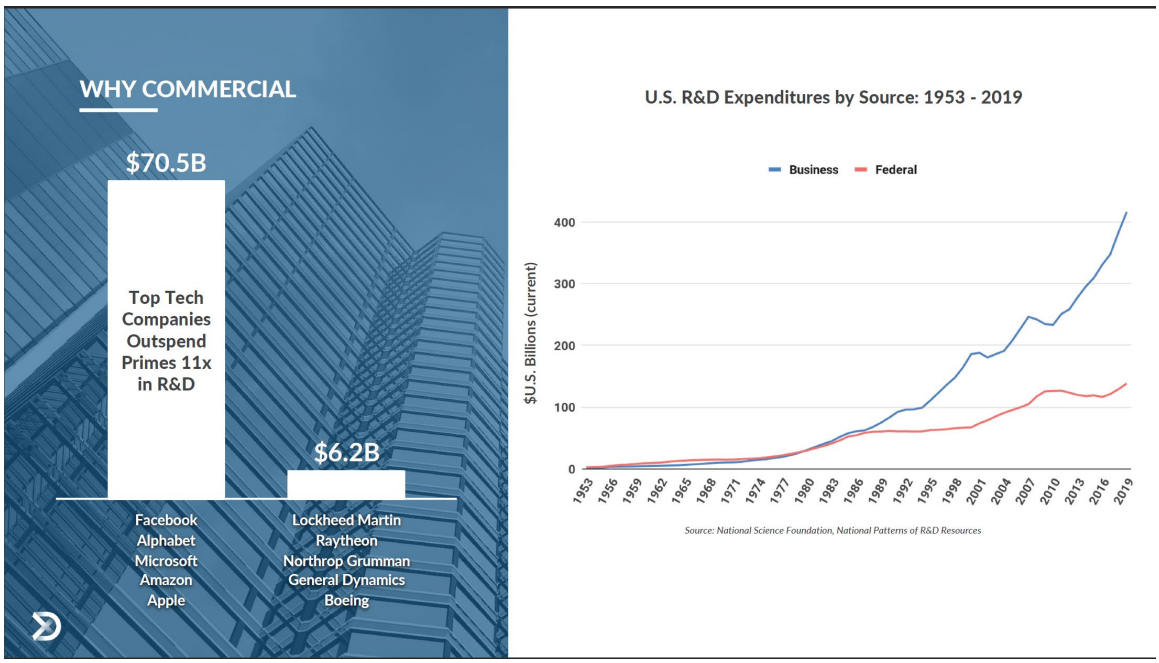

Figure 7. DIU R&D Money Analysis[66]

The Other Transaction (OT) agreements and authorities the DIU has access to allow the organization to access leading commercial technology and deliver solutions at commercial cost curves to the Department of Defense.[67] The DIU's simple process

[64] Steven Domingo, Mike Pero, and Leif Eiriksson, "SOCNORTH Brief with DIU" (PowerPoint, SOCNORTH Brief, DIU Silicon Valley, June 29, 2022), Appendix C.

[65] Domingo, Pero, and Eiriksson.

[66] Source: Domingo, Pero, and Eiriksson.

[67] Domingo, Pero, and Eiriksson.

allows faster time to award prototyping contracts and transition. It has access to a larger volume of defense contracts. Furthermore, it keeps the DOD partner in the room throughout project curation and creation.

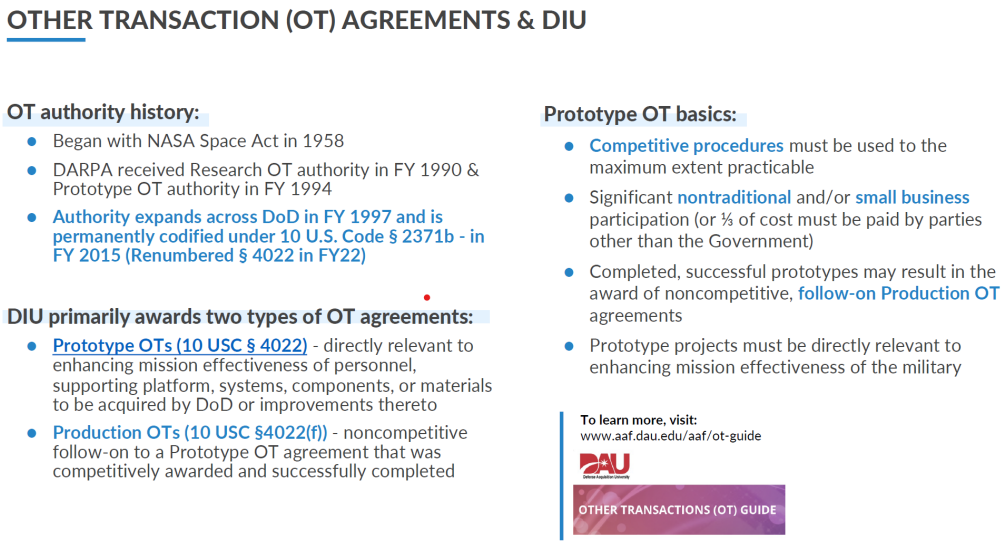

Figure 8. OT Agreements DIU can Access[68]

[68] Source: Domingo, Pero, and Eiriksson.

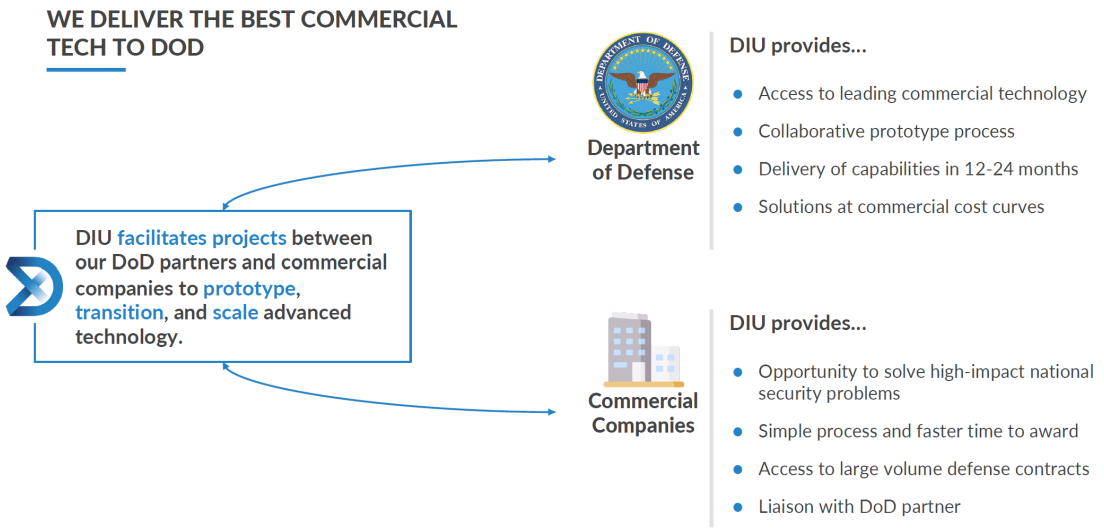

Figure 9. DIU as the Connective Tissue[69]

B. UNIQUE ACQUISITION LIFE CYCLE

Initially, a DOD partner brings a problem set to the DIU. The DIU and the DOD partner evaluate and understand the problem and do due diligence to confirm that the commercial market exists to address the DOD partner's problem adequately.[70] After the initial research in the market, an assessment has been conducted, Area of Interest (AOI) documents are produced, and Commercial Solutions Opening (CSO) is placed for the commercial market for private companies to bid.[71]

The CSO is a three-phased siphoning of potential ideas that commercial companies provide to address the DOD problem.[72] Phase one solicits digital proposals from numerous companies willing to attempt the DOD problem solution. Approximately ten days after digital solicitation, five to 20 companies are selected to proceed to phase two. Phase two evaluates proposals and assesses a short list of bidders to pitch or

[69] Source: Domingo, Pero, and Eiriksson.

[70] Domingo, Pero, and Eiriksson.

[71] Domingo, Pero, and Eiriksson.

[72] Domingo, Pero, and Eiriksson.

demonstrate their potential solution to the DOD problem. Phase two last approximately 60 to 90 days.[73] Phase three is the selection of commercial market companies or companies as contract awardees to solve the DOD problem. The entire filtration of ideas from the commercial market lasts approximately three months. Allowing the DOD rapid problem-solving and solution orientation. In contrast, the traditional acquisition process would take two years to achieve the same endpoint that the DIU has achieved by the end of the CSO.

After the CSO has concluded, prototyping of the contract awardees' solution begins. Prototyping, on average, with the DIU takes approximately 12 to 24 months.[74]

After the prototype has been completed, the DOD assesses the solution and determines whether to award a non-competitive follow-on agreement.[75] When the non-competitive follow-on agreement is awarded, a successful transition process occurs, and the DOD is delivered a successful problem-set solution, inherits the contract, and appropriately scales the adoption.

Throughout the unique project life cycle, the DOD partner has provided insight, direction, and assessment alongside the DIU. The continuous inclusion of the DOD partner in the project life cycle allows the DOD to ensure quality and ensures the warfighter's needs are met. The DIU lean project life cycle is fast and competitive, giving the DOD access to a greater pool of problem solutions. This unique project lifestyle is imperative to NSW because it provides the benefit of receiving a quality solution, appropriates the needs of the warfighter throughout the project life cycle, and, once in the hands of the warfighter, allows for continuous and rapid adaptation.

[73] Domingo, Pero, and Eiriksson.

[74] Domingo, Pero, and Eiriksson.

[75] Domingo, Pero, and Eiriksson.

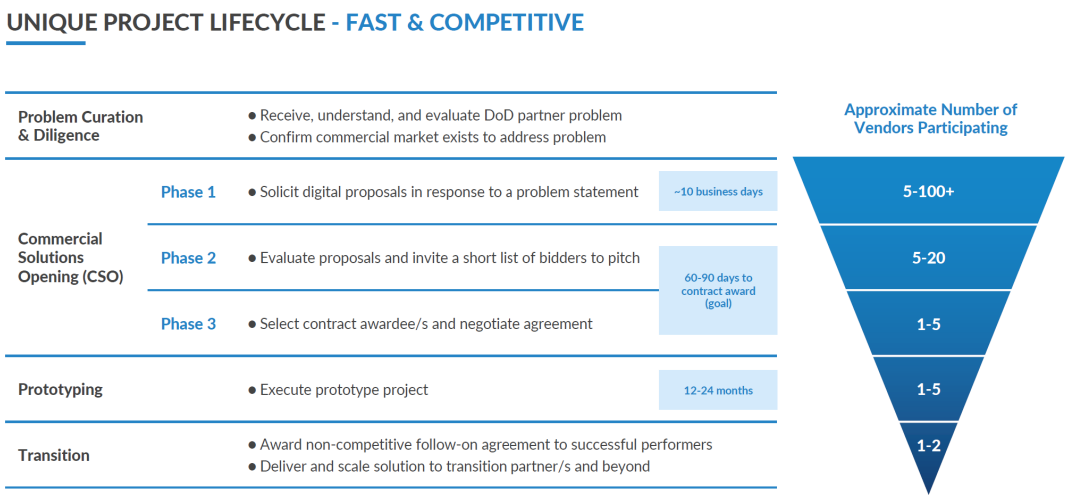

Figure 10. DIU Project Life cycle[76]

C. VENTURE CAPITALISM FOR THE DOD

The Department of Defense has a traditional acquisition program that funds projects based on service components. The DIU can incorporate additional funding lines to solve a problem that could benefit more than one DOD partner.[77] For example, if NSW goes to the DIU with a problem and that problem is also had by other government agencies, the DIU can negotiate different funding lines to accomplish the problem. In the example, NSW would retain primary stakeholdership and determine the project's direction; however, the other organizations can adapt the project for their needs without starting from scratch. Figure 11 displays the access to funding lines and various organizational partners that the DIU can bring to bear to find a solution to a problem.

[76] Source: Domingo, Pero, and Eiriksson.

[77] Domingo, Pero, and Eiriksson.

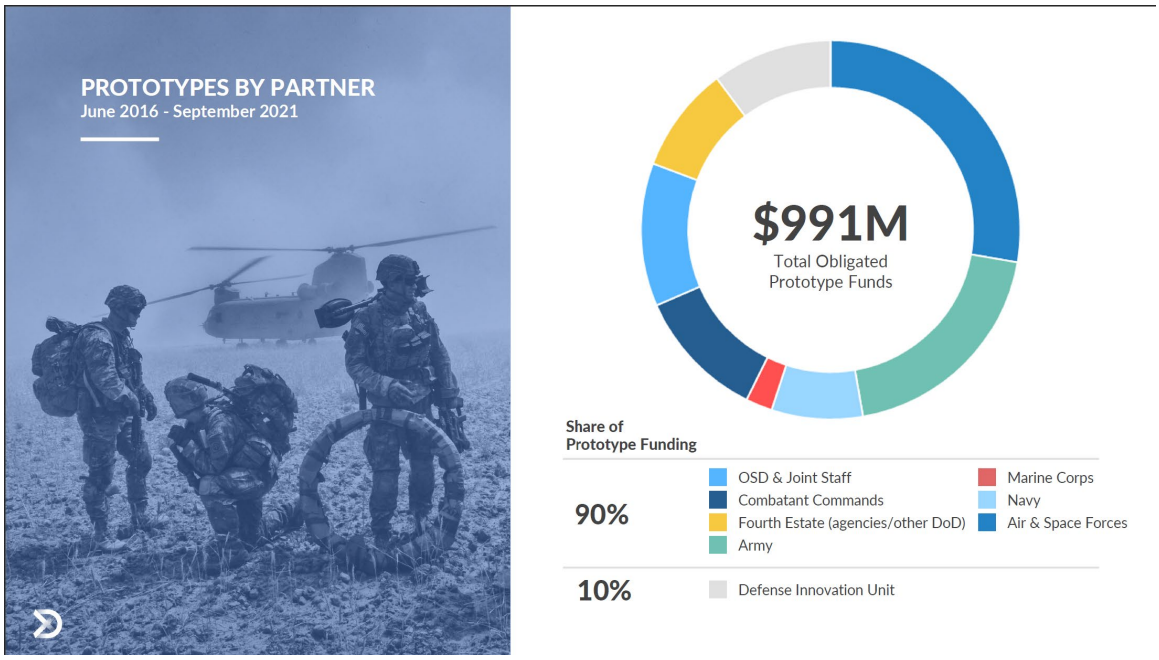

Figure 11. DIU Funding Line Capabilities[78]

[78] Source: Domingo, Pero, and Eiriksson.

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III. ENVISIONING STORY

A. ENVISIONING STORY OF THE PRESENT

Our NSW platoon just finished our winter warfare certification, passing qualification prior to our European deployment. A week before deploying, your boss comes into your office and says that he has urgent tasking from the Secretary of Defense, and our platoon is charged with the action. He describes a Russian oil facility in the western Siberian Arctic to have sprung a leak, and an environmental crisis has arisen. Due to intelligence and the involvement of other Russian alliance countries, something else may be occurring at that oil facility. Our platoon is tasked with providing a special reconnaissance of the site so that we can report back our findings. We have two days to begin mission execution.

As we are the qualified deploying Arctic force, we must find a way into this space. Disembarking from submarines is unlikely due to enemy early warning devices and being that close to a Russian facility would be difficult to get in undetected. We have one icebreaker, and that is in Antarctica, so we cannot use ship-born methods to access the AOR. Therefore, we must military free fall or disembark from an airplane with all required Arctic mobility equipment. To remain outside the enemy early detection capabilities, we must exit the plane a few hundred miles from the oil facility. Besides the logistical and administrative chain needed to accomplish the mission properly, your platoon has severe reservations about whether they would survive within the High Arctic during the mission.

In understanding the current capabilities within the envisioning story, we can now imagine the not-so-distant future and utilize modern technology to augment NSW expertise.

B. NEAR-FUTURE ENVISIONING STORY

The mission parameters and threat assessments remain the same as the present envisioning story. To reach our objective, we can now navigate through the High Arctic,

where the enemy will least expect us to approach. We disembark the airplane and unload the NSW Arctic Survivability Package. The package could consist of three vehicles with marsupial vehicles (smaller, more agile vehicles), and you could have an additional heated clothing layer for your PCU system. The vehicles would be outfitted for mounted survival and defensive capabilities. Those vehicles could travel across the varying high Arctic terrain while keeping you enclosed in a comfortable environment.

Moreover, those vehicles would supply your heated clothing layer with the power needed for each platoon member to stay warm. Once you and your platoon have driven as close as necessary, you park the vehicles before the enemy's early warning detection devices discover you. Once those vehicles are parked, you embark on the marsupial vehicles that also supply your heated clothing the power it needs and go under the enemy's early warning detection devices until you reach a point where the enemy may audibly detect you. You park those vehicles and patrol to objective. You can stay on objective for 72 to 96 hours to execute your mission. Each operator can remain focused on their mission the entire time because they are not worried about the Arctic environmentals potentially killing them. Once your mission is accomplished, you patrol back to the marsupial vehicles, take the marsupial vehicles back to the three primary vehicles, and proceed to extraction and mission accomplishment.

IV. UNDERSTANDING THE ARCTIC SURVIVABILITY PACKAGE ECOSYSTEM

A. ECOSYSTEM MAPPING

To understand the potential for adoption of the Arctic Survivability Package, we had to understand the ecosystem. the team identified the factors, organizations, infrastructure, and end users to gain a better understanding of how the Arctic Survivability Package could be produced.

1. Factors

The factors contributing to the potential success and adoption of the innovation are prominent within Silicon Valley, California. Numerous. venture capital firms drive the funding for private industry in Silicon Valley. The DOD is represented in Silicon Valley through the DIU and military communities' liaisons to the area. Other prominent factors were the testing ranges and private industry displays of product creations. The factors in the Silicon Valley region promote the ability to harvest many ideas from private industry and then support the ability to test and understand product potential.[79]

2. Organizations

The organizations that would promote rapid innovation are already in place within Silicon Valley. The DIU has multiple departments in place that generate many ideas and harvest potential private industry creations for the benefit of the Department of Defense. NPS also has the connections and research capabilities that promote innovation. These connections are with the DIU, Stanford, and private companies.[80] The organizations in place support the network connections needed, research capabilities, and historical references for innovation.

[79] Nicholas Dew, "Innovation Ecosystem Mapping" (Class, Navigating Ecosystems, Naval Postgraduate School, January 20, 2022).

[80] Dew.

3. End Users

The end users within the ecosystem are the NSW operator and NSW. Other end users within the ecosystem that could use the Arctic Survivability Package include the United States Navy, the United States Army, the United States Air Force, the United States Coast Guard, and other National Research laboratories. The private industry and companies creating the Arctic Survivability Package would also benefit as end users in selling their product potentially to commercial markets.[81] The end users in the ecosystem are all likely beneficiaries of the Arctic Survivability Package creation.

4. Infrastructure

The infrastructure within the ecosystem is established within Silicon Valley. The supply chain, ports, and shipping facilities are mature.[82] The San Francisco port also allows for international reach if needed. The primary software companies such as Google, Amazon, and Apple are all located in the area. Much like organizations, the schools within the area are already mature in their ability to research and help produce the Arctic Survivability Package. The infrastructure within the ecosystem is mature and primed to produce the Arctic Survivability Package.

Figure 12 and Figure 13 are visual representations of the Arctic Survivability Package ecosystem.

[81] Dew.

[82] Dew.

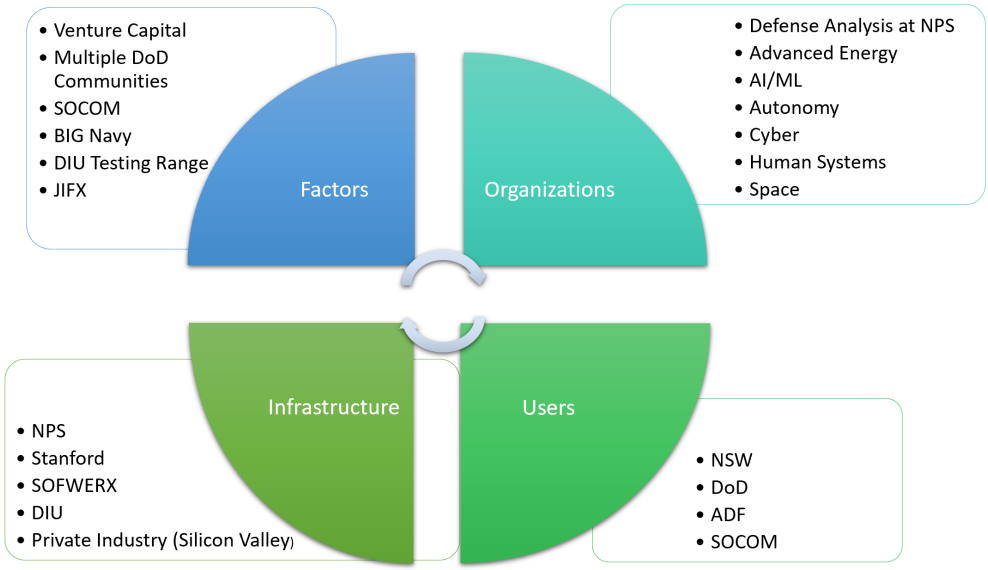

Figure 12. Ecosystem Map for Arctic Survivability Package[83]

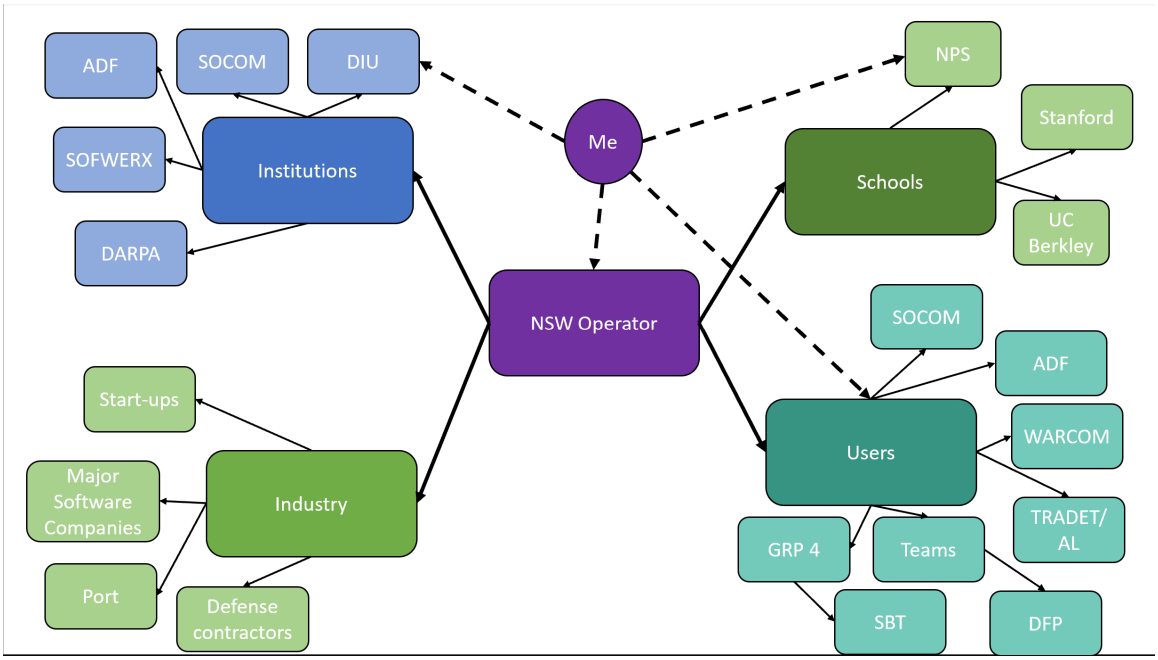

Figure 13. Ecosystem as a Different Graphic[84]

[83] Source: Dew.

[84] Source: Dew.

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V. APPROACH

The approach was modeled after DIU's current lean innovation adoption model. This model would allow for the rapid conglomeration of private industry ideas and how that industry would tackle our problem set. However, to reach the point upon which our team put the problem set and requirements out for public bids, we derived a three-phased approach. The three-phased approach starts with approach phase zero and proceeds through approach phase two.

A. APPROACH: PHASE 0

Phase zero began with understanding the NSW operator is currently unable to meet Arctic mission success. The Arctic is a specific environment with which the NSW operator is unfamiliar and unable to achieve mission effectiveness throughout all phases of their operation. Their primary focus is on staying alive within the Arctic environment. The team researched COTS heated clothing to understand augmenting the operator's heat capacity, which would allow for increased comfort within the Arctic. Additionally, through the Naval Postgraduate School's relationship with the DIU, the team learned of Human Resources products that already existed (such as the Retrofit Diver system). In understanding the current environmental factors and COTS products, I pitched the DIU the problem statement. I proposed a solution for a thermostatically insulated base layer clothing system. Upon project approval and partnership/residency with the DIU, our team decided the solution needed to be more incremental and encapsulate catastrophic solution achievement. After further meetings, we derived the root problem and began postulating solutions to decrease the effect of being 'cold' and increase the duration of the NSW operator within the Arctic. Phase zero has concluded with a successful DIU partnership and accurate root problem identification.

1. Approach: Phase 0—Problem Identification

The idea to provide NSW with survivability innovation for the Arctic began when I learned of DIU's wireless soldier project. The wireless soldier has communication wires

sewn into combat uniform fabric so that the operator does not require a specific communications setup on their ballistic kit. From this project, I wondered if harnessing and amplifying any heat produced by the wireless soldier system was possible. When I discovered that the wireless soldier system did not emit heat to the wearer, I wondered if we could create a system that would exhibit heat for the wearer. From this idea is how the problem of Arctic survivability for an NSW operator was derived, and then a potential solution was postulated.

I then created a pitch for the defense innovation unit to tackle Arctic survivability for the NSW operator. In this pitch, I discussed how an NSW operator was likely to survive only in a few sub-regions of the Arctic because of the changing yet harsh environmentals. The pitch conversation also determined whether a problem set like NSW Arctic survivability would be an appropriate problem to allocate resources to.

B. APPROACH: PHASE 1

Phase one begins with scoping the problem set. To scope the problem, we will choose from any current NATO Special Operations Force Arctic mission sets (focused on Special Reconnaissance, Over The Beach, or Direct Action) and show how NSW operators cannot achieve mission success. The mission set chosen will be based upon team decision as most advantageous to the NSW warfighter community and its ability to execute a successful Arctic operation. This will involve operational risk management and tactical assessments of each operational phase and their application to the chosen NATO Special Operation Forces Arctic mission. Through showcasing the points of contestation within each phase of the NATO mission set, we will be able to scope requirements and potential solutions for solving diminished effects of cold and increased duration for the operator within each operation phase. This will provide solutions for the micro aspects of the mission and for the macro aspects of the mission. The team and I will analyze the National Oceanic and Atmospheric Administration's quantitative records of climate surveys and qualitative data regarding temperature differentials within the Arctic. Phase one ends with the problem fully scoped and the direction for solutions to the problem set.

1. Approach: Phase 1—Problem Scoping

After my community's problem set and warfighter concern were demonstrated and accepted for partnership with the DIU, I met with Human Systems project manager Leif Eiriksson. The meeting was intended to refine the problem set and discover the base problem to understand the problem set better. We looked at the technologies and equipment supporting current cold weather operations. We looked at the training capacity that the NSW warfighter received. We broke down climate change, enemy early warning and detection capabilities, and where the inherent risk subsided within the NSW Arctic mission set.

From this, we understood three distinctive priorities for the base problem. The first was the focus of the NSW operator on survivability instead of mission effectiveness and completion. The second priority was how rapidly climate change affected the Arctic regions, allowing adversaries to employ their deterrence capabilities within the region. The third distinct priority was the inherent risk assumed not only to the warfighter but to all echelons of command within an Arctic mission set.

Breaking down the first priority is very simple to understand. During our discussions, we used past experiences and scenario development to understand how this is a priority. For example, in scenario development, the moment the NSW operator steps off the airplane into the high Arctic environment, his first thoughts will not be about the mission requirements and tasks at hand, but they will focus on survival. The first priority is the most important of the three because to be mission effective the NSW operator must focus on the mission from start to finish. If other variables supersede mission focus, it detracts from capability and implies a more significant limitation to the NSW operator. The environmentals of the High Arctic and sequential regions are a forcing function that limit the warfighter. So, in understanding this first priority, we adjourned to analyze further and generate ideas on how to allow the warfighter to have mission effectiveness as their primary focus while removing extreme cold weather survivability as a significant limiting factor to the warfighter.

Then we investigated numerous datasets involving climate change and open-source information regarding enemy early warning deterrence employment within the Arctic regions. For climate change, we looked at all the environmental and the differences in the six Arctic regions. As with the first priority, the second priority needed further analysis to determine what ideas or technological innovations we could provide to reduce environmental factoring and counter adversarial early warning and detection capabilities.

The third priority was the inherent risk assumed to all levels of command that would affect a potential Arctic mission. The warfighter would assume vast risk not only to survivability factors but as to the additional adversarial variables that could be expected when executing an operation or mission. Additional to the warfighter is the commander of the mission and the chain of command required for that Arctic mission. They would assume much more risk than they currently allow in other geographical areas because of Arctic environmental factors and equipment limitations. We sought to understand how to minimize risk for the chain of command and the warfighter with technological innovation.

With three priorities outlined as significant functions for the base problem, we ended the meeting by conducting follow-on research and returning with ideas to reach the base problem.

After a few days, we sat down and had another meeting. In this meeting, we were able to determine the base problem and potential avenues of approach to better equip the warfighter for an Arctic mission set. To buy down the inherent risk assumed at all levels of command, adapt to environmental factors and adversarial capabilities, and retain operator focus on mission effectiveness, we derived the base problem to be a function of warfighter survivability.

Essentially, warfighter survivability is providing the warfighter a means to no longer focus. on his survival outside of warfighting. To adequately address survivability within the Arctic, we understood that there must be two areas of concern addressed to adequately survive in all the Arctic regions, specifically the High Arctic region. The High

Arctic region was chosen out of specificity because the other ancillary regions are not as environmentally harsh. If NSW could operate in the High Arctic then they could operate in the ancillary Arctic regions.

The two areas of concern that needed to be addressed to solve the base problem and affect all three priorities were duration and cold.

Duration is the time available to the NSW operator within that region. With current capabilities available to an NSW operator, the High Arctic region is highly limited, if at all capable. Duration is affected by a power source. It is affected by fuel. It is affected by storms and environmental factors. It is affected by the operator's experience within the region. Most importantly, duration is affected by the logistical capability. Adversarial intentions highly limit the duration or areas in which we can operate. Numerous events could affect the duration or contingency duration in the area. To affect survivability, we need to allow the NSW warfighter the ability to remain in the Arctic region for as long as the mission requires and plan for contingency situations.

Cold directly applies to the feeling and health conditions that would affect operators in the field. The feeling of cold is not in the sense that an operator feels "chilly" but that he or she is so cold that their focus shifts away from the mission to surviving and to primordial lifesaving needs. Additionally, it is other injuries, such as frostbite, hypothermia, variable weather conditions, and shoulder seasons. An NSW operator's ability to be amphibious in the Arctic is limited, not due to the water and ice, but due to the current survival techniques and capabilities employed. To affect survivability, we need to remove the life-threatening concern of cold and cold causing injuries to the operator.

C. APPROACH: PHASE 2

Phase two begins with drafting the Area of Interest (AOI) for public bidding and solution capability demonstration of commercial partners with the DIU. In this phase, the team and I will set requirements for the AOI and draft a proposal. This proposal will be published for public and private companies to bid on a solution for the problem set. Phase two ends with the publishing of the AOI.

1. Approach: Phase 2 – AOI Drafting

Prior to drafting the AOIs, we began to discuss with senior NSW leaders possible desired COAs that would meet their policy efforts. One such COA proposal is displayed below.

The Arctic Survivability Package is a two phased approach to addressing the mobility/duration concern and concern the environment has on NSW operator survival.

Phase 1 (Duration Solution): will present the NSW operator with a mounted Arctic mobility package. Such a package would allow an NSW element to navigate the polar ice cap and Arctic tundra terrain while keeping the operators in a determinable environment. The Arctic mobility package would give the NSW operator two weeks of mission duration. Additionally, the Arctic mobility package would be capable of variable platform Insertion/Extraction. The Arctic mobility package will solve the Arctic mobility problem for the team and individual movement, facilitate ancillary equipment (communications, medical, IRF, organic fires) necessary for mission success, and be a power supply for Phase 2.

Phase 1 Recommendation: The Arctic Survivability Package is currently conceived to consist of three polar outfitted vehicles (recommended: Polar Expedition Toyota Hilux) that support two marsupial snow bikes (recommended: Timbersled) per Hilux.

Phase 2 (Survival): would present the NSW operator with individual heated clothing that could augment the current Protective Combat Uniform (PCU) load out and pair with the mounted Arctic mobility package from Phase 1. Phase 2 will allow the NSW operator 72–96 hours individual duration in the Arctic environment outside the Arctic Survivability Package. The unique heated clothing would add to the current PCU loadout to allow operator familiarity and ease of unit adoption. The heated clothing would receive power from elements of Phase 1 when co-located and power from a self-contained power unit when not co-located. This technology package would allow NSW operators to focus solely on mission effectiveness instead of simply surviving.

Ancillary areas of consideration within the problem set lie within the domain of operator delivery method. Further prototyping could explore similar capabilities for enhanced operator survivability within the near-surface and sub-surface domains. The package could provide NSW with a modular technology that can integrate into multiple mission sets.

The end state is to provide an NSW element the ability to respond rapidly to Arctic crisis/conflict. By utilizing the DIU's innovation generation and adoption practices, NSW can shape its Arctic Survivability Package, quickly enter the Arctic space, and rapidly adapt to the changing environment and adversarial capabilities. Modernizing NSW's Arctic capabilities would allow the NSW element to "roll up the garage door" and execute missions in an otherwise prohibitively inhospitable environment.

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VI. CONCLUSION

A. WHAT WAS ACCOMPLISHED

The team has been able to map the Arctic defense ecosystem and COAs that will lead private industry to prototype and yield solutions for NSW operator's survivability in the Arctic. AOI documents have been prepared so that once WARCOM is ready to advance, these documents will be waiting as a baseline for execution. Additionally, numerous discussions were held with SOCNORTH and their Arctic experts to provide a congruent vision for the project path and future Arctic warfare capabilities. Much of the team's accomplishments have been oriented around gathering multiple communities' Arctic experts and discussing strategy, policy, and coinciding commanders' viewpoints for a more unified effort toward Arctic warfare.

B. STRENGTHS AND LIMITATIONS

Some of the strengths the Arctic Survivability Package solves is the refinement of a particular NSW problem set. The system's strengths are the increased duration an operator can survive in the High Arctic. The Arctic Survivability Package also will decrease the effect of cold on the NSW operator, enhancing their mindset for mission accomplishment.

Potential limitations of the Arctic Survivability Package are specific to equipment fielded. The effectiveness of potential vehicles over Arctic terrain is a potential limitation. The battery or power source for the heated clothing layer is a potential limitation. The delivery method of the vehicles is also a potential limitation. While there are potential limitations to the Arctic Survivability Package, the benefits of creating a disruptive innovation within Arctic survivability have greater benefits.

C. CHALLENGES FACED

Many of the team's challenges were due to the traditional acquisition process and the need for a unified directional strategy for Arctic operations. The traditional acquisition process needs a threshold of requirements prior to innovation. These

requirements are derived from the directional strategy NSW is trying to accomplish. If there is no directional strategy, then requirements cannot be specified there for the traditional acquisition process cannot be utilized.

While the traditional acquisition process needs a substantiated requirements threshold, the DIU's lean innovation adoption model and production capabilities allow us to understand there is a generalized requirement and need for creating the Arctic Survivability Package. With a general requirement and need for the Arctic Survivability Package, we can utilize the lean innovation adoption process to produce the Arctic Survivability Package and innovate in an area of warfare that has not seen recent innovation.

D. LESSONS LEARNED

Technological innovation does not replace exquisite expertise. Our team understands the need for deep expertise in Arctic warfare. However, a pairing of technological innovation and exquisite expertise is needed to allow access and placement within the Arctic. To buy down risk, technological innovations need to be produced and tested by Arctic warfare experts. Because the future of warfare is global, NSW will have to be able to deploy across many regions. If our Arctic innovation proves reliable, then NSW can buy down the risk of non-Arctic expert NSW operators and allow the NSW Arctic experts to amplify training and preparation.

E. APPLICATION, SIGNIFICANCE, AND AUDIENCE FOR RESULTS

Once complete, the Arctic Survivability Package will allow NSW operators the ability to execute Arctic and Antarctic mission sets. It will also increase the survivability of operators across various mission set spectrums. It will reorient mission success as the primary focus of NSW operators.

The Arctic Survivability Package is significant because it is a technological innovation paired with exquisite expertise within a previously relegated warfare environment. Also, it dramatically reduces the risk to the chain of command and the warfighter.

The desired audience for the Arctic Survivability Package is NSW, SOF, SOCOM, United States Navy, the United States military, and eventually, the private marketplace.

F. IMPLEMENTATION GUIDANCE

Our team recommends an expeditionary warfare mindset when executing the phased approach for the Arctic problem set. Our team recommends that speed is security when conducting missions in the Arctic. NSW units must be flexible enough to adapt to the dynamic environment. They will have to use speed to insert and extract before enemy detection. If detected, the unit must use speed to create distance to maximize potential security. The expeditionary mindset of being able to project force rapidly, for short iterations, utilizing speed as security, and mobility for deeper penetration, informed the team's decision-making process and course of action development.

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APPENDIX A. FROM SAND TO SNOW

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From Sand to Snow: Historical Lessons for Special Operations in the Arctic

As Naval Special Warfare's (NSW) Sea Air Land (SEAL) units face the prospect of irregular warfare in the arctic, they should look to historical examples for inspiration—and caution. We advocate that SEAL teams and other Special Operations Forces consider two experiments from WWII for insight into the challenges and opportunities of arctic operations. First, the highly successful cooperation between the Long Range Desert Group and Special Air Service (SAS) in North Africa (1940-1943); a collaboration that turned the Sahara into a launching ground for raids against Axis airfields. The second, a far-fetched and ultimately quixotic scheme to use specially trained "Forcemen" (1941-1942) as guerillas in snowbound areas, leveraging winter as a "fourth element" of combat, alongside ground, air, and sea. Think of it as Lawrence of Arabia, but on snowmobiles, and without the success.

Today, climate change has reshaped the earth's ultimate impasse—the Arctic's "icy sea"—into an arena for strategic competition. Contemporaneously, the tactics of "gray zone" or "hybrid warfare" have created demand for military units that operate below the threshold of large-scale combat operations. These trends in mind, earlier efforts to asymmetrically capitalize on austere environments are pregnant with lessons for special operators. Both the Long Range Desert Group and Forcemen suggest the need for dedicated infiltration units, collaboration with scientific experts, and the use of indigenous knowledge. They also offer warnings about ambitions that exceed the practical limits of technology, logistics, or an ally's political will. It would, of course, be foolish to draw direct prescriptions from the 1940s, but it is equally reckless to disregard hard-won experience.

The Arctic: A New Challenge and Flashpoint of Competition

U.S. policymakers increasingly recognize the arctic as a site of competition and hemispheric connection. This is a major revision to long-held assumptions. In 1904, one

of the first geostrategists, Halford Mackinder, depicted the region as an "icy sea" safely barricading the "heartland" of Eurasia. Writing in 1942, Nicholas Spykman agreed, assigning equally scant importance to the "Polar Mediterranean": or what he called "the greatest inhospitable area on the surface of the globe." True, airplanes and submarines might cross the arctic, but ice and weather made it, fundamentally, an impediment to trans-hemispheric connection. Certainly, conflict between conventional or special operations forces in the region seemed unlikely—fantasies like "Ice Station Zebra" (1968) aside.

A great deal has changed. In 2010, Caitlyn L. Antrim flipped Mackinder and Spykman on their heads, arguing in the *Naval War College Review* that the arctic was increasingly both "the next geographical pivot" and new "rimland" of global geopolitics. Economic and political orientation of the world is also shifting, with the respective parties looking at polar projection charts every increasingly instead of the classical Mercator charts. The Russian President Vladimir Putin certainly intuited as much several years earlier. In 2003, he remarked that "'two or three degrees' could be a good thing for Russia as its people would no longer need fur coats and its agricultural production could rise." The Arctic Institute has acknowledged the thawing of permafrost and previously unworkable lands has given the Russian economy the ability to be the world's foremost supplier of fertilizer and 20 percent of the world's wheat supplier. The undeniable increase in Russian economic advantage, as their northern lands thaw, has prompted additional Russian outlook towards the Arctic circle for the vast resources and strategic capabilities it contains. As the Russians increase their oil drilling capacities to extract 22% of the world's oil reserves from the Arctic, they are also signing trade navigation exclusivity deals with India and China for utilization of the Northeastern Sea Route (commonly referred to as the Northern Sea Route). The retreat of sea ice in the Arctic has also caught the economic and strategic interest of the Chinese Communist Party (CCP); a self-described a 'near-polar power,' investing in a 'polar silk road.' The state of regional competition in mind, realistic planning and adaptation for arctic operations are imperatives for the Department of Defense in general and (given the region's maritime and littoral geography) Navy SEALs in particular.

Of course, various forms of "strategic competition" in the arctic have a long and active history—not least the search for a Northwest Passage and the Cold War. To this day, Denmark's dogsled patrol in Greenland was and is an example of Arctic special operations well worth studying. New U.S. Coast Guard icebreakers are in the yards–a symmetrical response to Russia's 38 active ice breakers and the eight Chinese ice breakers. And naturally, submariners continue a dangerous game of blind man's bluff.

All of the above can inform Naval Special Warfare as they accelerate distinctive maritime special operations capabilities to expand United States irregular deterrence options, *but* the scale of strategic competition at the intersection of "gray zone" warfare and a warming arctic are today, *sui generis*. Adapting units to operate in this space is a novel challenge for which there is no simple analog. Where, then, to start? Ironically, the best roadmap for arctic competition may come from the Sahara Desert and the last "great power" war.

Striking Across the Desert: The Long Range Desert Group and Special Air Service

Like the sea lanes opening across the arctic today, the digging of the Suez Canal in 1869 transformed Egypt into a vital theater for the British Empire; the gateway to an artery of commerce streaming to South and Southeast Asia. In 1940, as Axis forces pushed east from Italian occupied Libya toward Alexandria, the British Near East HQ scrambled to slow the advance and protect this strategic line of communication. One solution was to attack extended Axis supply lines, funneled down a narrow coastal road, and flanked by desert. But how? The Libyan "sand sea"–most assumed–was an impassable barrier that effectively screened the coast road from attack. It was a costly assumption, soon exploited by a combination of scientific know-how, innovation, and military audacity.

The British officer Ralph Bagnold had all three qualities spades. A veteran of the fighting at Ypres, Bagnold was posted to Egypt in 1926. There, in 1932, he and a group of officers modified Model T Fords and conducted the first motorized crossing of the Libyan Desert. Three years later, his scientific treatise *The Physics of Blown Sand and Desert Dunes* broke new ground in the field. NASA eventually named Martian dunes after him.

Bangold put this knowledge and ambition to good use during the Second World War by organizing the "Long Range Desert Group." Formed in 1940, the group proposed to range out from Egypt into a vast, untracked desert. This "piracy on the high desert"—as Bagnold put it—required the modification of trucks for desert operations, as well as specific navigational equipment. His sun compass, for example, provided the LRDG with the ability to navigate through fields of iron deposits scattered across the Libyan sands. More basically, the unit exploited Italian pretensions of "controlling" Libya's interior, turning an ungoverned space into a refuge for special operations. It was all, "rather like yachting," Bagnold later remembered.

The Long Range Desert Group had some initial success as a reconnaissance unit, but it was David Stirling—the founder of the Special Air Service–who recognized its possibilities as a transport arm for special operations. Though initially conceived of as an

airborne force, the SAS found in the Long Range Desert Group its critical enabler. Driving to and from coastal raids, the group soon became known by the commandos as the "Libyan Taxi Service." In a few months, this small force destroyed 367 Axis aircraft, along with fuel dumps and munitions depots–and in doing so also forced the diversion of untold resources to guard rear-echelon bases. In the touch-and-go battles of 1941–1942, it is impossible to discount the potential strategic effects of those losses.

Here were new technologies and skills, honed by civilians in peacetime, that under the exigencies of war became a lethal combination. Assumptions about the Libyan desert as an impassable space reflected an Axis failure of imagination–one that British special operators were eager to exploit. The future of the arctic presents similar opportunities and risks.

Operation Plough: The Forcemen and the Limits of Ambition

World War II also offers a less sanguine example of special operations in a new environment. Namely, a failed attempt in 1941–1942 to use North American "Forcemen" as snow commandos in Northern Europe. The concept was the brainchild of Geffoery Pyke: a polymath with a creative flair who resembled Bagnold in some respects. Hired to think outside the box, Pyke believed that in the same way the desert provided mobility for irregular warfare, so too could snow. He argued for seeing "snow as a fourth element—a sea which flows over most of Europe each year." Commandos dropped into the continent could use that element to raid and attrite Axis forces and infrastructure.

With high-level political support (from Churchill and Mountbatten no less), Pyke's idea gained traction in the form of "Operation Plough" (As in snowplow, get it?). The basic idea had some precedent. British and Norwegian commandos tied down a large German garrison in Norway; most famously by raiding the Vemork heavy-water plant. Building on that example, Pyke saw opportunities to drop commandos into Europe and attack critical infrastructure with motorized snow-sleds from Norway to the Italian Alps. In support, the automaker Studebacker designed a snowmobile prototype: the M-29 Weasel, a two-ton, four passenger vehicle that could make 30mph on snow. Fleshing out the plan, by 1942, the Canadians and Americans had contributed 800 men each to the effort, creating the First Special Service Force, or Forcemen.

Pyke, though, was no Bagnold. By the fall of 1943, allied leaders abandoned Operation Plough, owing chiefly to hostility from the Royal Air Force (reluctant to reassign bombers to ferry sleds) and unanswered logistical concerns. To wit, how exactly did Pyke intend to fuel and maintain the sleds once deployed behind enemy lines? While Bagnold had decades of experience in motorized transport on sand, Pyke had little interest in the gritty details of maintenance and sustainment in snowy conditions. He had

even less time for objections from Norwegian leaders in exile, who voiced understandable opposition to destroying the civilian infrastructure Norway would need for its post-war recovery. Pyke's vaulting ambitions frustrated, LTC Robert Frederick took command of the unit in 1943, ditched its skis and snow-sleds and recreated the Forcemen as an all-purpose assault force. In that capacity the Forcemen would fight and eventually exhaust themselves at the Winter Line at Monte la Difensa during the allied invasion of Italy.

If the Long Range Desert Group suggests the possibilities of special operations in a changing arctic, the experience of the Forcemen is a cautionary tale. It might be true, as Pyke complained before his death, that "bad manners to new ideas…are a Public Offence," but so too is wishful thinking when lives are at stake. Men like T.E. Lawrence and Bagnold relied on decades and even centuries of local experience in desert movement. Pyke's ambitions were flimsily moored to technological promise and fantasy. His failure should remind special operators to appreciate the limits of technology and the difficulties of sustaining resource intensive conflict in an austere environment.

The Polar Mediterranean: WWII Lessons for the Arctic.

The Arctic is a generational challenge, but like most challenges it is also an opportunity. NSW has previously excelled in challenging and novel environments, whether it was the NCDU's at the Normandy beaches, the UDT's amphibious landing preparation at Tarawa, the raids along the Mekong, or the desert and mountains of Iraq and Afghanistan. Rear Admiral H.W. Howard III, Commander of NSW, recently remarked: "As the Nation's Naval Commando force that solves hard problems, Naval Special Warfare initiated a deliberate, comprehensive, and urgent transformation in 2020 to meet these new threats and create irregular warfare options that strengthen and complement deterrence." NSW's enduring and continual lean adaptation ability to execute surgical strikes or gain access and placement in otherwise unknown environments, makes it the Special Operations Force (SOF) of choice the United States can bring to bear in the predominantly maritime environment of the Arctic.

Still, a new environment requires new thinking—about unit organization, technology and strategy. Luckily, historical examples can inform efforts today. As NSW units should consider six lessons from the experiences of the LRDG and Forcemen.

> **Testing Technology.** The LRDG deployed technologies that had been developed over a decade (at least) of trial and error in the desert. That proven capability was readily adapted to military purposes. In contrast, Operation Plough began with a military ambition (guerrilla warfare in snowy conditions) and attempted to create

a technological capability from scratch. Wishing the M-29 Weasel was up to the challenge would not make it so.

NSW can utilize advances in the civilian sector that has enhanced the scientific exploration in the region. Whether it is in material sciences that could augment Arctic clothing, communications equipment, medical care advancements in cold weather environments, or the advancements of fuel augmentation for transportation units. The adaptation of civilian sector polar advancements would rapidly allow NSW to catch up and outpace strategic competitors in the Arctic. Granted, some Arctic problems would require technological capabilities to be created from scratch. But adapting what is already available is likely more effective and economical.

Dedicated Transportation Units. In both desert and arctic operations, the problems of movement and sustainment are special tasks unto themselves. The LRDG and SAS were most successful as a collaboration. One trained for transport and the other for raiding and sabotage. In Plough, conventional RAF units balked at transporting Forcemen and their equipment, scuttling the operation. Such institutional frictions endure today, and might be mitigated by dedicating one or multiple Special Boat Teams (SBT) to the arctic environment. Another avenue could be an organic mounted Arctic mobility package. A package that would facilitate navigation across polar terrain, team and individual movement, command and control functions, and environmental protection. These packages could model the expeditionary warfare packages that NSW has previously used in Africa.

Local Priorities and Indigenous Knowledge. Desert operators eagerly used indigenous intelligence about water, clothing, and enemy movements. Pyke, by contrast, failed to coordinate with or learn from ongoing Norwegian resistance operations. SEALs should not make the same mistake. Arctic peoples have a deep reservoir of knowledge. So too arctic allies like Denmark, Norway, and Canada. Closer to home, the Alaska State Defense Force (ASDF) is the modern successor to the Alaska Territorial Guard (ATG) which was created as a first line of territorial defense against the Imperial Japanese during World War II. During the war, the ATG served as scouts – the military's eyes and ears against Japanese invasion. Being from the local communities, the ASDF is already seasoned to Alaska's arctic conditions and would embolden NSW Arctic efforts.

Collaboration with Scientific Experts. Bagnold made his foundational discoveries for the LRDG years before the outbreak of hostilities. His area specific knowledge stands in sharp relief to Pyke's abstract ideas. Pyke may have

enjoyed high-level political support, but it served him little when confronting concrete problems. With scientific focus on the polar regions, NSW has a window to enter the scientific conversations and collaborate with scientific experts and fund research. If NSW collaborates with scientific experts then it can remain abreast of the foundational discoveries and adapt capabilities at a higher rate of change.

The Pretensions of Control. In Libya, the Italian mirage of control over the Libyan Desert was ruthlessly exploited by the SAS and LRDG. Today the northern reaches of Greenland, Canada, Svalbard, Alaska, and Siberia have parallels to the under-governed "sand seas" of the Libyan Desert. Protecting these spaces from infiltration will require more than assumptions. With the maritime environment rapidly opening up in the Arctic, NSW must make a concerted effort to conduct operations, training and experiments in the region. By doing so it will provide its operators the familiarity with the environment and alongside the 2019 Department of Defense Arctic Strategy, build Arctic awareness for NSW units.

One Man's Wall is another Man's Bridge. Relatedly, LRDG's success relied on the failure of Italian and German imagination. Bagnold saw the desert as a connective space rather than a barrier; a cognitive feat that allowed the LRDG to surprise the Axis. Pyke was still more imaginative, but without a grounding in practical knowledge about military necessity, Operation Plough remained the stuff of fiction. In recognition of its growing importance. NSW must gain practical military knowledge of the region so that its operators can execute necessary operations. In defense of the homeland and competing strategically in the Arctic, operations will not be relegated to the war fiction section of a library, but as successful and effective operations within the historical section.

None of this makes a case for vulgarly copying the past. Rather, it is a thought experiment about the challenges and opportunities posed by special operations in new environments. How leaders faced this same question at the nadir of the allied war effort is a useful exercise, but not likely to lead to many concrete recommendations. Still, the experiences of the Long Range Desert Group and Forcemen offer several warnings from which modern special operators can benefit. After all, the best way to commemorate military sacrifice is to relentlessly drive to advance distinctive irregular options that increase national leverage and expand the ways we deter the Nation's adversaries.

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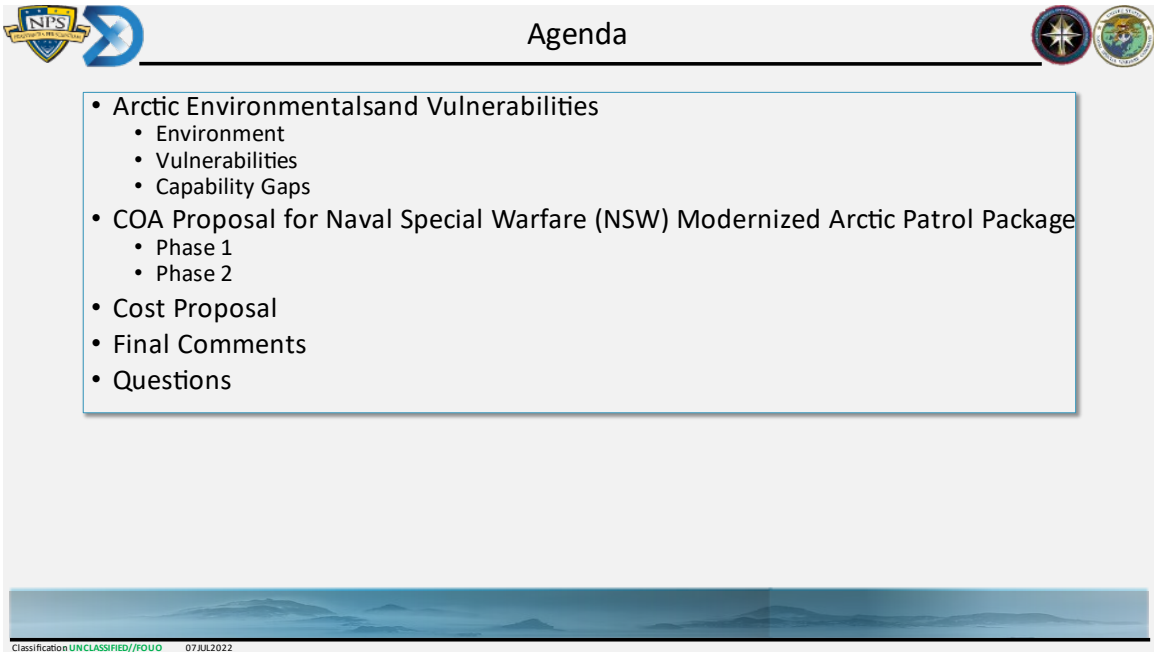
APPENDIX B. SOCNORTH AND NSW EXECUTIVE SLIDE SHOW, 1ST ITERATION



Arctic Environmentals and Vulnerabilities

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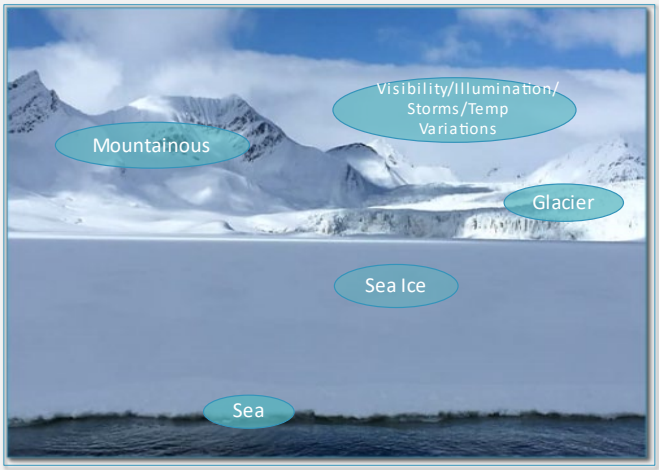
Arctic Environment

Arctic is a combination of 6 zones above the 60th parallel

Environment of Polar Arctic:

- Atmospheric Variations
  - Illumination (5%100%)
  - Visibility (clear–white out)
  - Storms (Blizzard +100mph winds)
  - Temperatures (37.4F to -104F)
  - Ultraviolet Ray Consideration
- Short summers and long winters
  - Rapid thaw in (Jun/Jul/Aug) Rapid freeze in (Oct/Nov)
- Extensive snow and ice cover in winter
  - Great expanses of sea, snow, and ice
- Varying topography
  - Mountainous, ravine, jagged sea ice, plains



CDR Risk: **Very High** - as the environment forces the operator to focus on survival and not mission effectiveness

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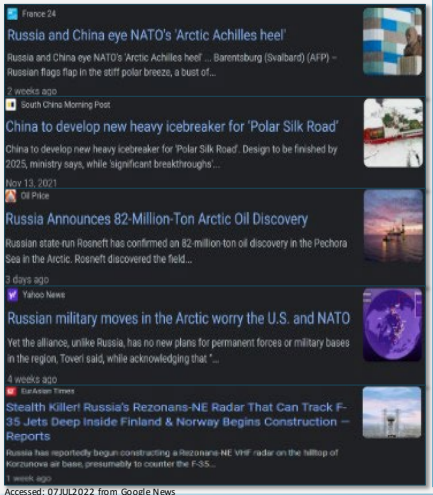
Hybrid Warfare Threats & Vulnerabilities



Accessed: 07JUL2022 from Google News

Former Russian President Medvedev declared that the state's "first and main task is to turn the Arctic into a resource base for Russia" (Klare, 2013)

Northern Sea Route (Northeast Passage):
- 119.4% increase of ships utilizing the route in 2020 from 2019 (Applying less than 50.1mi to U.S.)

Sub-sea ice oil and gas reserves
- Russia controls 14% of worlds oil/gas reserves to the U.S. 11%, in the Arctic
- 66% of all Russian oil and gas is estimated to be found in Russia's exclusive economic in the Arctic (Claes & Moe, 2014)

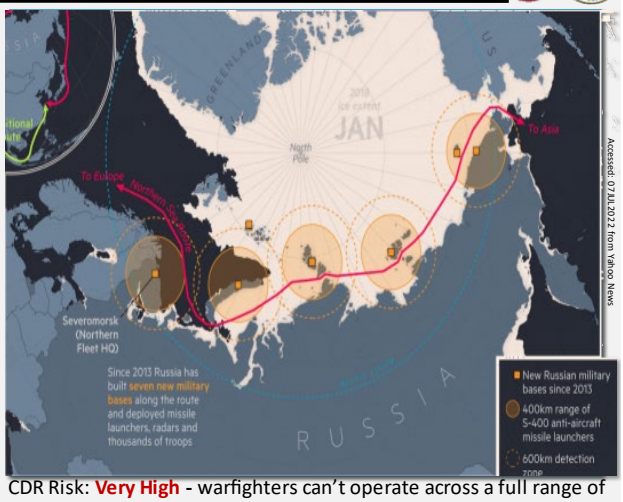
Rare Earth minerals
- Russian Arctic sites produce:
  - 40 % of the world's palladium (fuel cells/batteries)
  - 20 % of the world's diamonds (chip production/mining services)
  - 15 % of the world's platinum (catalytic converters/electrical contacts)

Ice Breakers
- China =8 (civilian and military)
- Russia=70 (civilian and military)
- U.S.=3 (+4 civilian)

CDR Risk: **HIGH** - Left uncontested, incremental gains from increased aggression could result in a fait accompli, with long-term strategic benefits from our competitors.

NATO and U.S. Force Capability Gaps

NSW lacks the ability to:
- Meet 2019 Arctic DOD Strategy/Navy's Blue Arctic
  - ✓ Building Arctic awareness
  - X Enhancing Arctic operations
  - X Strengthening the rules-based order in the Arctic
- Meet NATO Arctic Mission Set requirements
  - X Collective defense
  - X Crisis management (Limited Infrastructure/Architecture)
  - ✓ Cooperative security
- Execute all 5 phases of an NSW operation
  - Phase 0 (Planning) **MODERATE**
    - Operator success highly limited lack of previous operations
  - Phase 1 (INSERT) **HIGH**
    - Operator success highly limited due to weather, and ability to deploy personnel/equipment
  - Phase 2 (INFIL) **VERY HIGH**
    - Operator success highly limited due to survivability, weather, and ability to access
  - Phase 3 (AOO) **VERY HIGH**
    - Operator success highly limited due to survivability, weather, and enemy retaliatory capabilities
  - Phase 4 (EXFIL) **VERY HIGH**
    - Operator success highly limited due to survivability, weather, and ability to access
  - Phase 5 (EXTRACT) **HIGH**
    - Operator success highly limited due to weather, and ability to retrieve personnel/equipment



CDR Risk: **Very High** - warfighters can't operate across a full range of missions to preserve peace and respond to crises in the region.

NSW Modernized Arctic Patrol Package

The Arctic Survivability Package (Phase 1 & 2) will allow NSW operators multi-week access and placement in the range of Arctic Competition Continuum mission sets, without need for additional specialization schools, and fill the capability gap for NSW operators to successfully execute mission sets in the 6 regions of the Arctic

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Phase 1 - Desired Capabilities

Modernized Mounted Arctic Mobility Package (MAMP)

- Augment team and individual movements
- Support a multi-week mission
- Support 8-12 operators per multi-week patrol
- Capable of variable deployment/recovery methods
  - *Roll-on/off, pallet drop*
- Capable to support ±2000lb cargo capacity in addition to the operators
- Scalable solutions
  - *varying team size/mission duration/cargo capacity is desired to increase cross domain capabilities*

The MAMP is currently proposed to consist of:

3 polar outfitted Trucks (Top Right)

- Capable of navigating and supporting NSW element movement across European Arctic and Polar Arctic surfaces
- Provide NSW element ancillary equipment (communications, medical, IRF, organic fires)
- Provide Phase 2 with organic prolonged power source for survival

2 marsupial snow bikes (Bottom Right) per Truck

- Intended to move smaller element closer to intended target with lower detection signatures
  - *Quieter*
  - *Smaller profile*
  - *Quick for paced INFIL/EXFIL/reactionary purposes*
- Provide Phase 2 with organic prolonged power source for survival

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Phase 2 - Desired capabilities

Individual Heated Clothing

- Augment the current PCU load out
- Allow the NSW operator 72-96 hour individual duration in the Arctic environment outside of the MAMP
- Receive power from elements of the MAMP (Phase 1) when co - located
  - Via umbilical power cord
- Support multi-week missions
  - If longer missions required, then Norwegian and Danish specialization schools recommended
- Scalable solutions
  - Mission duration
  - Cross-domain and cross-platform capable (MFF/DCS/CCA/CCM)
  - Power sources
  - IR Defeat clothing can go over heated clothing

**Products of ACTIONHEAT - does not reflect actual prototypes desired but does show intent of heated clothing system and possible accomplishment

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Final Comments and Questions

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Phase 1 &2 Option A/B Cost Proposals

Phase 1

- Warfighter Endorsement
- Prototype Option A
  - 1x Truck = $400,000
  - 2x Snow Bike = $12,800
  - 2x Vehicle* = $13,000
  - Developmental Fund =$300,000
  - Total = $726,000
- Prototype Option B
  - 3x Truck = $1,200,000
  - 6x Snow Bike = $76,800
  - 6x Vehicle* = $78,000
  - Developmental Fund =$900,000
  - Total = $2,254,000

* = potential vehicle other than snow bike

Phase 2

- Warfighter Endorsement
- Prototype Option A
  - 8x Clothing Sets = $ 600,000 -$700,000
- Prototype Option B
  - 12x Clothing Sets =$ 900,000 -$1,000,000

Total

- Warfighter Endorsement
- Prototype Option A
  - $1,426,000
- Prototype Option B
  - $3,254,000

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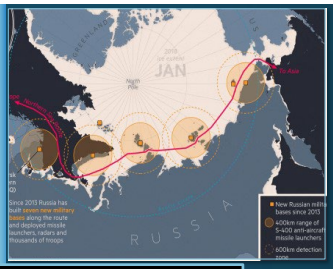
Problem (Why)

Trade:
- Northern Sea Trade Route (Northeast Passage)
- 119.4% increase of ships utilizing the route in 2020 from 2019

Sub-sea ice oil and gas reserves
- Estimated 90 Billion barrels of oil (13% of worlds reserves) = 2/3 Russian Gas Exports

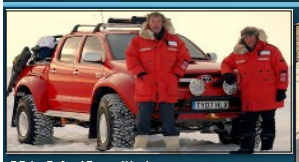
Rare earth minerals
- Russian Arctic sites produce:
  - 40 % of the world's palladium
  - 20 % of the world's diamonds
  - 15 % of the world's platinum



NSW Capability Gap

- Inability to execute 3/5 phases of NSW mission set
  - X Phase 0/1/2/3/4 /5
- Can't meet NATO Arctic Mission Set requirements
  - X collective defense
  - X crisis management
  - ✓ cooperative security
- Meet 2019 Arctic DOD Strategy
  - ✓ Building Arctic awareness
  - X Enhancing Arctic operations
  - X Strengthening the rulebased order in the Arctic

NSW Modernized Arctic Package



3 Polar Outfitted Toyota Hilux's
- Capable of navigating and supporting NSW element movement across European Arctic and Polar Arctic surfaces
- Provide NSW element ancillary equipment (comms, med, IRF, organic fires)
- Provide Phase 2 with organic prolonged power source for survival

2 Marsupial Snow Bikes per Hilux
- Intended to move smaller element closer to intended TGT with lower detection signatures
  - Quieter/Smaller profile
  - Quick for paced INRL/EXRL/IAD
  - Provide Phase 2 with organic prolonged power source for survival

Solution Phase 1 (Mounted Arctic Mobility Package)

Heated Clothing
- augment the current PCU load out
- allow the NSW operator **72 -96 hour** individual duration in the Arctic environment outside of the MA MP
- receive power from Phase 1 when co-located
- support multi-week missions
- scalable solutions
  - *mission duration*
  - *cross-domain and cross-platform capable (MIF/DCS/CCA /CCM)*
  - *Power sources*

Solution Phase 2 (Individual Heated Clothing)

APPENDIX C. SOCNORTH AND NSW EXECUTIVE SLIDE SHOW, 2ND ITERATION

This brief was also utilized in presenting to NORTHCOM and the Alaska Defense Force (ADF)

Arctic SOCNORTH
Aug 23, 2022

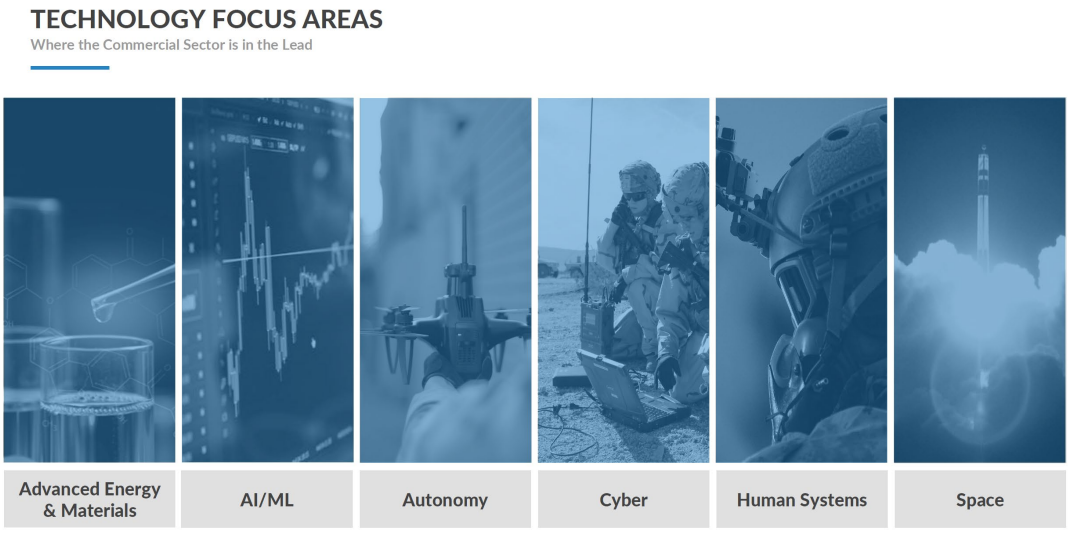
LT Joe Domingo
LT Mike Pero
Leif W Eiriksson

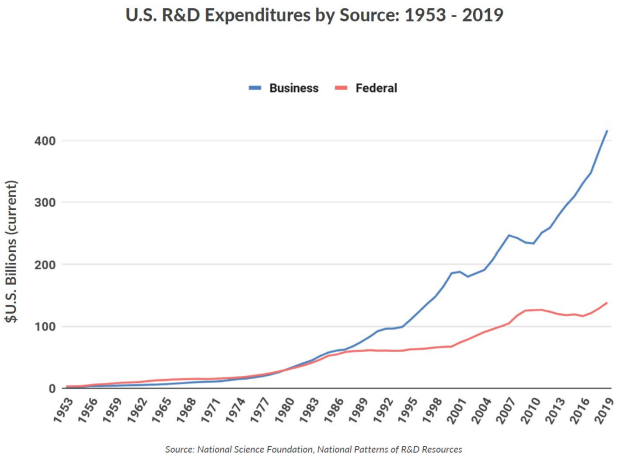
AGENDA

All times MST

1400-1420	Intros and DIU Overview
1420-1440	Arctic Survivability Project Overview
1440-1500	Discussion


TECHNOLOGY DOMINANCE IS THE NEW GLOBAL BATTLEGROUND
"Success no longer goes to the country that develops a new technology first, but rather to the one that better integrates it and adapts its way of fighting."
2018 National Defense Strategy
Photo credit: Rocket Lab
Accelerating Commercial Technology For National Security
3


TECHNOLOGY FOCUS AREAS
Where the Commercial Sector is in the Lead
Advanced Energy & Materials
AI/ML
Autonomy
Cyber
Human Systems
Space



WE DELIVER THE BEST COMMERCIAL TECH TO DOD

DIU facilitates projects between our DoD partners and commercial companies to prototype, transition, and scale advanced technology.

Department of Defense

DIU provides...

- Access to leading commercial technology
- Collaborative prototype process
- Delivery of capabilities in 12-24 months
- Solutions at commercial cost curves

Commercial Companies

DIU provides...

- Opportunity to solve high-impact national security problems
- Simple process and faster time to award
- Access to large volume defense contracts
- Liaison with DoD partner

OTHER TRANSACTION (OT) AGREEMENTS & DIU

OT authority history:

- Began with NASA Space Act in 1958
- DARPA received Research OT authority in FY 1990 & Prototype OT authority in FY 1994
- **Authority expands across DoD in FY 1997 and is permanently codified under 10 U.S. Code § 2371b - in FY 2015 (Renumbered § 4022 in FY22)**

DIU primarily awards two types of OT agreements:

- **Prototype OTs (10 USC § 4022)** - directly relevant to enhancing mission effectiveness of personnel, supporting platform, systems, components, or materials to be acquired by DoD or improvements thereto
- **Production OTs (10 USC §4022(f))** - noncompetitive follow-on to a Prototype OT agreement that was competitively awarded and successfully completed

Prototype OT basics:

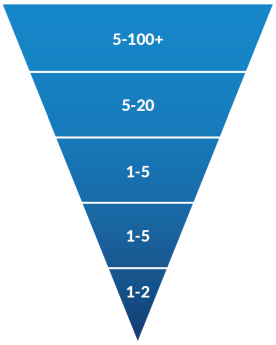
- **Competitive procedures** must be used to the maximum extent practicable
- Significant **nontraditional** and/or **small business** participation (or ⅓ of cost must be paid by parties other than the Government)
- Completed, successful prototypes may result in the award of noncompetitive, **follow-on Production OT** agreements
- Prototype projects must be directly relevant to enhancing mission effectiveness of the military

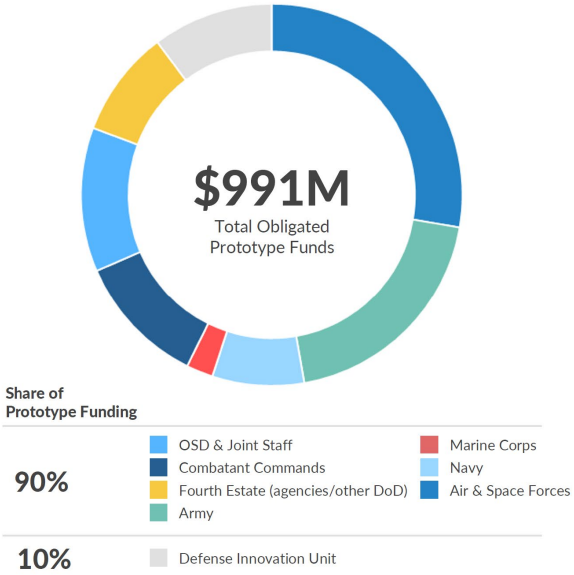
To learn more, visit:
www.aaf.dau.edu/aaf/ot-guide

UNIQUE PROJECT LIFECYCLE - FAST & COMPETITIVE

Problem Curation & Diligence		• Receive, understand, and evaluate DoD partner problem • Confirm commercial market exists to address problem	
Commercial Solutions Opening (CSO)	**Phase 1**	• Solicit digital proposals in response to a problem statement	~10 business days
	Phase 2	• Evaluate proposals and invite a short list of bidders to pitch	60-90 days to contract award (goal)
	Phase 3	• Select contract awardee/s and negotiate agreement	
Prototyping		• Execute prototype project	12-24 months
Transition		• Award non-competitive follow-on agreement to successful performers • Deliver and scale solution to transition partner/s and beyond	

Approximate Number of Vendors Participating



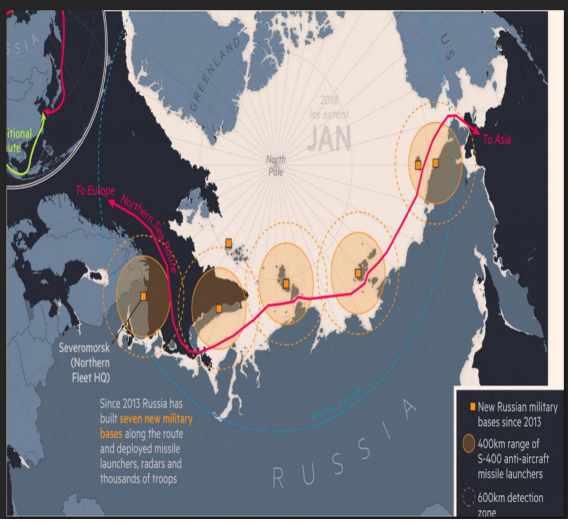


Arctic Survivability Project Summary

Accelerating Commercial Technology for National Security | 10

Why / Mission

- To have to ability to quickly access all regions in the Arctic
- Respond to crisis events
- Have the ability to coordinate, and conducts special operations
- Assure allies and partners
- Compete below the level of armed conflict
- Deter irregular and conventional threats
- Set conditions to execute contingency operations to defend the United States and its interests.



Phase 1 - Desired Capabilities

•**Modernized Mounted Arctic Mobility Package**

- Support 8-12 operators per multi-week patrol
- Capable of variable deployment/recovery methods
- Scalable solutions
  - *varying team size/mission duration/cargo capacity is desired to increase cross-domain capabilities*

•**Current Ideas:**

3 polar outfitted vehicles

- Capable of navigating and supporting NSW element movement across European Arctic and Polar Arctic surfaces
- Provide NSW element ancillary equipment (communications, medical, IRF, organic fires)
- Provide Phase 2 with organic prolonged power source for survival

2 marsupial vehicles

- *Quieter*
- *Smaller profile lower detection signatures*
- *Quick for paced INFIL/EXFIL/reactionary purposes*
- Provide Phase 2 with organic prolonged power source for survival

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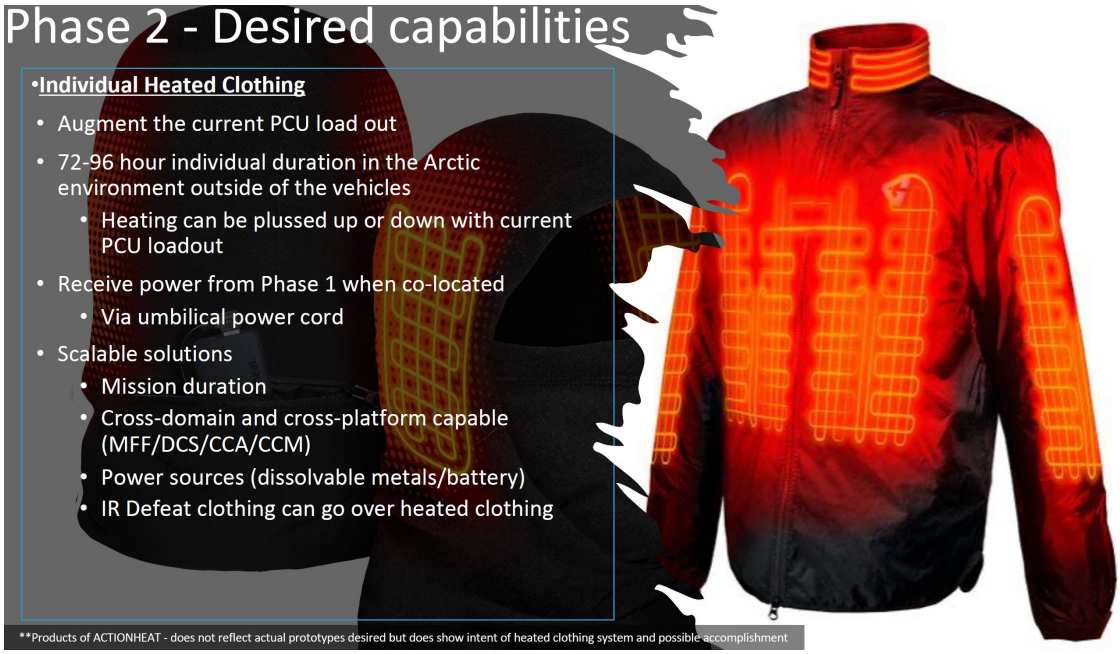
Phase 2 - Desired capabilities
•Individual Heated Clothing
• Augment the current PCU load out
• 72-96 hour individual duration in the Arctic environment outside of the vehicles
• Heating can be plussed up or down with current PCU loadout
• Receive power from Phase 1 when co-located
• Via umbilical power cord
• Scalable solutions
• Mission duration
• Cross-domain and cross-platform capable (MFF/DCS/CCA/CCM)
• Power sources (dissolvable metals/battery)
• IR Defeat clothing can go over heated clothing
**Products of ACTIONHEAT - does not reflect actual prototypes desired but does show intent of heated clothing system and possible accomplishment


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