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Challenges to Innovation at the Naval Surface Warfare Centers

June 2025

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Naval Postgraduate School

Prepared for the Naval Postgraduate School, Monterey, CA 93943.

ACQUISITION RESEARCH PROGRAM
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ABSTRACT

The Navy's Naval Surface Warfare Centers are slated for providing innovative, cost-effective solutions for the Warfighter, but how innovative are the Centers compared to industry and commercial, and how can the Centers be improved? This study explores the topic with a mixed qualitative and quantitative analysis focused on a scoped definition of innovation and successful innovation practices with source material solely from publicly available sources, and ties together a comparative picture of government versus successful commercial entities. The innovation definitions and theories reveal areas of concentration like funding and leadership buy-in, which are poled from various sources including National Defense Appropriations Acts, acquisition training materials, and years of Government Accountability Office studies to compare the Centers, other government innovation focused entities, and successful commercial entities against, thus providing multiple layers of comparison. The study groups and categorizes observations into a scoring table revealing the Warfare Centers are deeply constrained, and provides a basis of measure for the current state and future measures that could be used to understand the innovation potential of the Centers or other entities. Additional recommendations are provided to enable realignment of the Warfare Centers and other government research entities to successful innovative organizations.

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ACKNOWLEDGMENTS

I would like to thank the Department of Defense and especially the Department of the Navy with all of its fine personnel for many opportunities in life, including the opportunity for graduate studies. The faculty and staff at the Naval Postgraduate School are simply amazing and I cannot thank you all enough for the experiences gained; and a special thank you to my advisors/readers/professors Dr. Mortlock and Capt. Dunlap, USN, Ret., who were two of my favorites. Lastly, a big thank you to folks at the Naval Surface Warfare Center Dahlgren and especially the Battle Management System team for 13+ great years of new and unique challenges; and I hope this paper elevates some of our struggles that we continually fought day in and day out, while providing options for improvement. God Bless America.

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LIST OF ACRONYMS AND ABBREVIATIONS

ATO	Authority to Operate
CAP	Capstone Applied Project
COA	Courses of Action
COTS	Commercial-Off-The-Shelf
CR	Continuing Resolution
DAS	Defense Acquisition System
DAU	Defense Acquisition University
DAWIA	Defense Acquisition Workforce Improvement Act
DevSecOps	Development, Security, and Operations
DIB	Defense Innovation Board
DIU	Defense Innovation Unit
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
FY	Fiscal Year
GAO	Government Accountability Office
GE	General Electric
JCIDS	Joint Capabilities Integration and Development System
NAVSEA	Naval Sea Systems Command
NDAA	National Defense Authorization Act
NPS	Naval Postgraduate School
NSA	Naval Support Activity
NSF	Naval Support Facility
NSWC	Naval Surface Warfare Center
O&M	Operations and Maintenance
PPBE	Planning, Programming, Budgeting, and Execution
R&D	Research and Development
RDTE	Research, Development, Test, and Evaluation
SOCOM	Special Operations Command

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I. INTRODUCTION

A. PROBLEM STATEMENT

The United States Department of Defense (DoD) is considered to be the most powerful military in the world (Global Firepower, 2024a), backed by a funding line equivalent to sum of multiple of its nearest competitors (Global Firepower, 2024b), a combined military-industrial complex unrivaled in the rest of the world, and relying on a body of research that has provided a clear technological advantage. With more than 75,000 employees across 33 activities under the Naval Sea System Command's enterprise, Naval Surface Warfare Centers (NSWC) are uniquely situated to be aware of the complex requirements, mission needs, and urgency of warfighters (Naval Sea Systems Command, 2024c). The Warfare Centers are expected to "supply the technical operations, people, technology, engineering services, and products needed to equip and support…warfighters' needs" while also supplying support services to maintain these needs for today's and future systems (Naval Sea Systems Command, 2024c). U.S. adversaries and threats, operating with small budgets but at a transformative and agile scale, have shown an ability to close the technological advantage gap while increasing materiel availability; thus forcing the DoD to focus on faster product creation, development, production, and deployment (Govini, 2021). The DoD has further created multiple boards and units (Defense Innovation Board, 2024a; Defense Innovation Unit, 2024a) under multiple National Defense Authorization Acts (NDAA) to leverage "innovation" toward new solutions instead of heavily leveraging NSWC, implying roadblocks to being innovative.

B. RESEARCH QUESTIONS AND PURPOSE

This research answers three key questions:

1. How can NSWC be optimized to be more innovative and enable new product creation?

2. Are government rules and policies altering the "innovative marketplace" in favor of commercial or industry partners vs. government labs?

3. Are Warfare Centers operating more as a government entity or as a regulated commercial entity?

The purpose of this research is to establish a scope of what innovation is and what best innovation practices for an organization look like; understand how the DoD and its acquisition processes are setup with an emphasis toward innovation implementation or roadblocks; understand successful examples of innovation to gain lessons and observations for successful product creation; explore multiple DoD and non-DoD organizations to understand the difference between governmental and commercial enterprises; and tie all of the above observations back to NSWC, specifically the largest of the Centers: NSWC Dahlgren. The research identifies roadblocks that limit or impede the ability to be innovative in the DoD, specifically at Warfare Centers like NSWC Dahlgren. The research studies challenges that impede or limit materiel solutions from quickly developing and fielding. Lastly, the research identifies differences between the innovation and development environment of government verses commercial enterprises.

C. RESEARCH APPROACH

To answer the research questions, this capstone applied project (CAP) gathers both qualitative and quantitative data to enable a case-study comparative approach. The research leverages publicly available sources, which limit insights into organizations, financials, and decisions.

The CAP delves into innovation, just what it means to be innovative, and more importantly, key elements that enable an innovative idea to transition into a reality. Because the DoD utilizes an extensive system for all development and acquisitions, the research explores the Defense Acquisition System (DAS) and its acquisition frameworks to understand how they should apply to enabling or limiting innovation; and how this system impacts executing or building an innovative idea. These components are combined to develop a scoring metric to be "innovative in the DoD" and enable a comparison between multiple entities. An additional secondary comparison metric is provided by Kelly Johnson's 14 Rules, which have been credited for innovative success at Lockheed Martin's

Skunk Works, to provide an industry perspective on innovation, and how these same entities would perform in a competitive industry environment (Lockheed Martin, 2024c).

The entities to be compared range from successful industry entities, through standard DoD program offices following DAS, specific DoD entities or teams setup to be innovative, and government labs, specifically NSWC Dahlgren. Elon Musk's Starlink and Lockheed Martin's Skunk Works are assessed as they are widely considered successful, innovative industry entities that have worked and continue to work with the DoD (Lockheed Martin, 2024b; Tripathy, 2022). DoD program offices operate within the DoD 5000 series policies (Defense Acquisition University, 2004; Office of the Under Secretary of Defense for Acquisition and Sustainment, 2022b, 2022a), enabling insight. The DoD has recognized that innovation is not easy or intuitive, and has setup two identities to focus on both making the DoD more innovative and to actually put innovative practices into use: the Defense Innovation Unit (DIU) and the Defense Innovation Board (DIB) (Defense Innovation Board, 2016, 2024b; Defense Innovation Unit, 2024a). The research assesses innovation across the Navy's NSWC with focus on NSWC Dahlgren, to provide the government lab perspective which contains an extensive engineering knowledgebase that should be very innovative and more well informed to answer warfighter threats than most external entities (Govini, 2021).

To provide additional background, history, and recommendations; this research explores how government and industry partners are taught about the DAS through Defense Acquisition Workforce Improvement Act (DAWIA) and the associated Defense Acquisition University (DAU) (DAW 2018 Edition with Supplement V, 2024). Government policy, typically from above the DoD, as well as how funding impacts acquisition can be found in the NDAA's (NDAA, 2019; NDAA, 2021a; NDAA, 2021b; NDAA, 2022; NDAA, 2023). How the DoD and Navy specifically are or are not investing in both innovation and their government labs through their budget requests is researched. Lastly, the Section 809 Panel which was mandated to help the DoD improve acquisition and processes (Defense Technical Information Center, 2024), as well as the Government Accountability Office (GAO) which acts as a congressional third-party assessor (Government Accountability Office, 2015), are explored to provide additional insight.

D. SUMMARY

This chapter introduces the opinion that the DoD is less competitive, less advanced, and losing the technological ground to adversaries who have become far more agile and adept at developing capabilities quicker while spending less. The DoD has fully recognized that it must be more innovative and acquire capabilities more efficiently, but is hamstrung with its behemoth size, rules, and policies that it must operate under or forces itself to operate under. The research seeks to understand how the DoD can be more innovative, and more specifically, how the Navy can leverage the expertise of the Warfare Centers. To enable a comparison between government and industry entities, a set of measures for how innovative and how well these entities could acquire innovative solutions within the confines of DoD processes is developed along with an additional set of industry developed measures to enable further comparison. To further tie the comparisons together, the research explores how DoD acquisition education is impacting implementing innovative practices; and explores several third-party reviews for historical recommendations and findings that affect successful innovation and acquisition. The culmination reveals existing capabilities, limitations, and changes needed to reinvigorate DoD innovation.

II. LITERATURE REVIEW

A. DEFINING INNOVATION, KEY CHARACTERISTICS, AND DEVELOPMENT PATHS

To limit the scope of the CAP, definitions and understanding of how innovation is being used provides a basis of comparison for linkages in this paper.

1. Basic Innovation Definition

Innovation, in its simplest form, is a new idea, method, or device (Merriam-Webster, 2024), and innovators or idea generators are typically an extremely small population in an organization. Implementing this innovation, in any organization, is however typically the harder and more challenging problem, thus a balance needs to be found to enable creators to create and for the creation to be created (LaMorte, 2022). Within the DoD specifically, additional casual factors such as acceptance, cost, schedule, risk, and usefulness (versus just a non-materiel doctrine, organizational, or training analysis) of the idea must be considered; all of which are stated in DoDD 5000.01 to enable successful product acquisition and program execution (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2022b). Further, DoDD 5000 wants to "develop a culture of innovation" (p. 4) by encouraging managers to "seek, develop, and implement initiatives to streamline and improve the Defense Acquisition System (DAS)" (p. 4) while empowering those same managers, allowing and promoting tailored acquisition approaches, using data driven analysis, and emphasizing product support (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2022b). Thus, innovation in the DoD is much more than simply creating a new product or idea; there's a cultural change required.

2. Diffusion of Innovation Theory

The Diffusion of Innovations by Everett Rogers attempts to explain how a product or idea gains acceptance, as shown in Figure 1, from its creation to actual implementation acceptance and then implementation (Rogers, 1962). People and decision makers will

either be accepting of or rejecting/not supporting the idea but have the ability to change their stance with time, idea or product maturity, and overall better information.

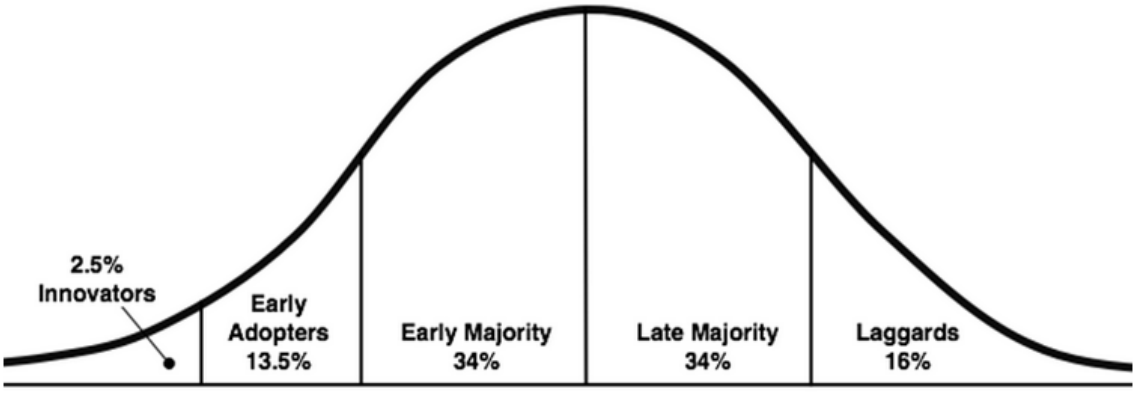

Figure 1. Distribution of Innovators to Acceptance. Source: LaMorte (2022).

The theory shows that the actual idea generator is typically an extremely small portion of the population (2.5%), yet must convince roughly half of a potential population of peers and decision makers (Early Adopters and Early Majority) before the innovation can move forward into fruition; and even still there can be roadblocks presented by later adopters when in decision authority or with differing priorities (LaMorte, 2022).

3. Product vs. Consumer Development Paths

Steve Blank , known for his Lean LaunchPad course at the U.S. National Science Foundation's Innovation Corps (National Science Foundation, 2024) and his Hacking for Defense course that has been widely adopted by the DoD and many universities (Hacking for Defense, n.d.), is no stranger to innovation and thinking outside the box. He wrote "The Four Steps to the Epiphany" in 2005, with an update in 2006, which centers around innovative product development, company mindsets, and customer expectations. Much like the DoDD 5000 series, he identifies cost, schedule, company stakeholder buyoff or investment, and customer needs as key drivers to innovation adoption, but he goes a step further: Mr. Blank conveys the classic Product Development pathway and a different customer focused or Customer Development pathway (Blank, 2006).

The traditional product development path, largely adopted in the 1950s which happened to coincide with the large boom of the military-industrial complex (Kitch, 2020), starts with an idea on how to solve a problem or perceived gap (Blank, 2006). The idea gains acceptance by company management for a material solution that would likely fill a gap, requests funding to prototype, and then kicks off development (Blank, 2006). Development moves into the Alpha/Beta Test stage where additional lobbying happens with some very limited customer interaction and most importantly, the start of marketing toward the shiny new product, gaining more funding and acceptance from management and other investment stakeholders while also trying to separate the product from the competition (Blank, 2006). Note that only after significant investment with development staff, prototyping, and initial testing is the consumer or user starting to be considered with the product, which having cleared planned testing, is ready for production with the managerial expectation of success. The product is launched and provided to the customer, and thus the first real consumer test of the product quickly happens resulting in success or failure (Blank, 2006). Comparing the product development methodology to the standard major acquisition framework of DoDD 5000, as shown in Figure 2, results in a close similarity at least so far as steps are concerned, and thus for innovation, there are multiple similarities both in the challenges and the outcome.

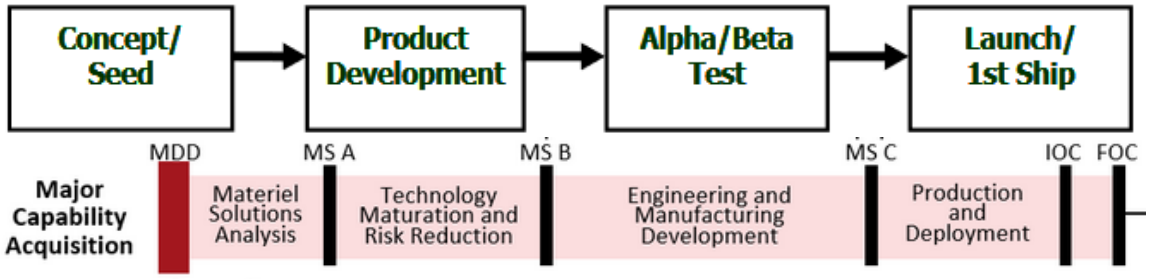

Figure 2. Product Development Path vs. DoD's Major Capability Acquisition. Source: Blank (2006), top; Office of the Under Secretary of Defense for Acquisition and Sustainment (2022a), bottom.

The newer consumer development path uses the same product development pathway, but adds on multiple customer, stakeholder, and market iterations and research to

inform the product and its development; resulting in more applicable and well defined requirements with user and stakeholder feedback loops, better modeling, and continuous validation of the product through its development (Blank, 2006). While this additional process may appear to be more effort, the feedback will typically result in a quicker production and more usable product as all stakeholders engage in continuous learning and enable adaptation of the product to the now defined and transforming market needs (Blank, 2006). Again, comparing to the newer DoDD 5000 acquisition frameworks as shown in Figure 3, there are multiple examples where a combination of urgency; stakeholder and user feedback; and iterative design emerge in more rapid or continuous acquisition processes (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2022a).

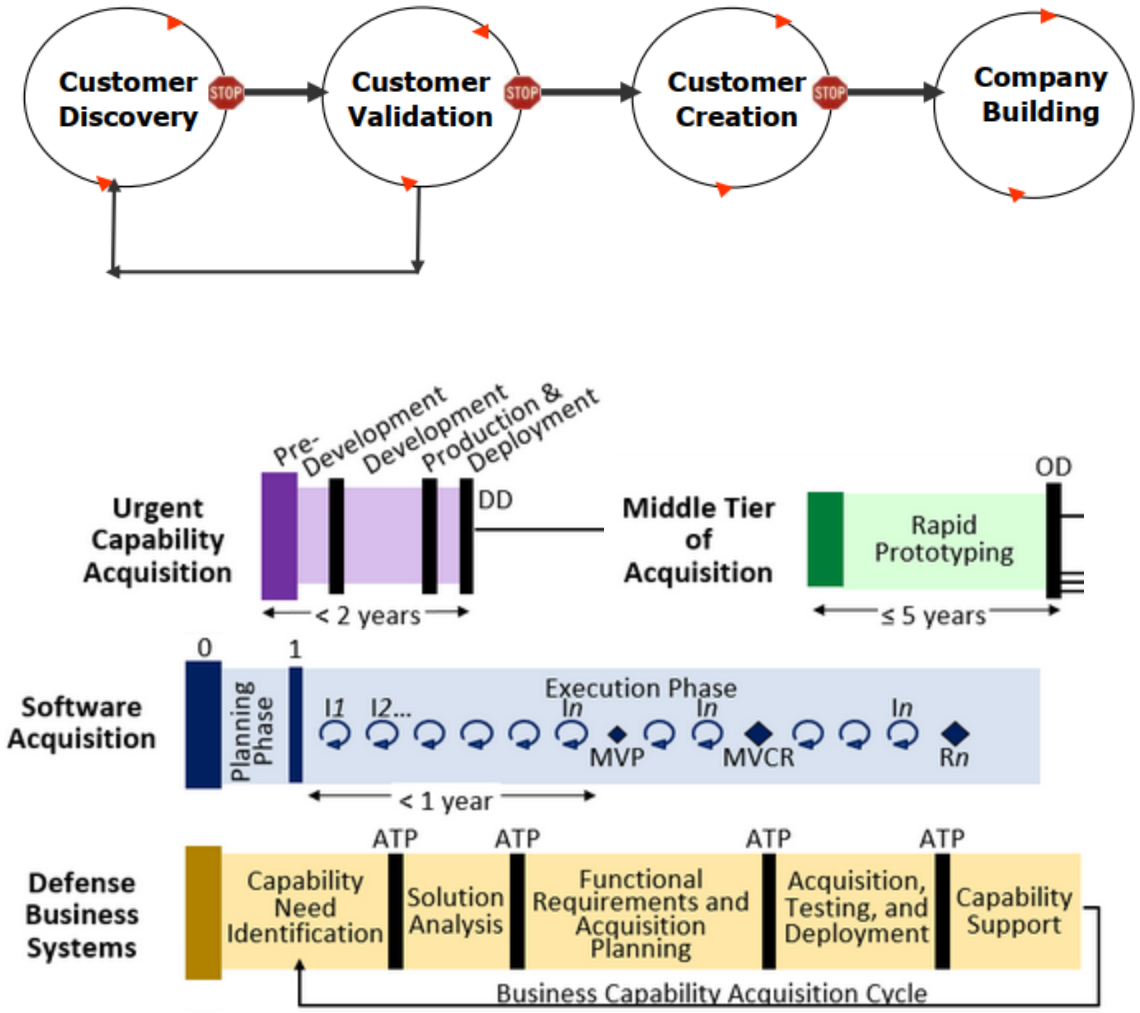

Figure 3. Consumer Development Path vs. DoD's Additional Acquisition Frameworks. Source: Blank (2006), top; Office of the Under Secretary of Defense for Acquisition and Sustainment (2022a), bottom

B. ACQUISITION IN THE DOD

1. The Defense Acquisition System

The DAS has long been established, though the latest reformation applicable to this content was established on 9 September 2020 with a small update on 28 July 2022 through the DoD Directive 5000.01 The Defense Acquisition System and released by the Secretary of Defense (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2022b); thus applying leadership approval and buy-off. The directive itself is

approximately five pages in its Section 1, but leverages significant direction, especially for innovation. Assuming that a directive or policy prioritizes its direction as most do, its first two policy points speak to the warfighter through a focus on "deliver performance at the speed of relevance" (p. 4) and to smart acquisitions by directing managers to "conduct system of systems analysis" (p. 4) for their programs. The third point directs managers to "develop a culture of innovation" (p. 5):

> Creativity and critical thinking will guide acquisition business practice. Acquisition professionals will seek, develop, and implement initiatives to streamline and improve the DAS. Managers at every level will consider and adopt innovative practices, including best commercial practices and electronic business solutions, that reduce cycle time and cost, and encourage teamwork. (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2022b, p. 5)

This policy statement, while acquisition focused, speaks to the larger push of DoD to think outside of the normal and well-established processes to expedite acquisition, better meet customer needs, improve efficiencies, and ultimately produce better and faster products. Continuing into the policy, there are several sections that bode well for a program office or acquisition plan to utilize NSWC or other government developers due to the insight, ability to control, test facilities, data rights, funding and contracting flexibility, knowledge bases, and direct warfighter engagement. Government entities emphasize competition to include planning for data rights, responding to the operational community, managing effectively with a focus on affordability including long-term cost and sustainment, planning for product support, conducting integrated test and evaluation, deploying interoperable systems, maintaining a professional workforce, maintaining data transparency, maintaining records effectively, and employing a collaborative process (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2022b). One shortcoming for NSWC or other government developmental centers is their inherent limitation that they are primarily research and evaluation centers (Naval Sea Systems Command, 2024c) verse sustainment organizations; this does not mean however that these centers cannot perform sustainment functions (Naval Sea Systems Command, 2024c) and likely should to a degree to enable product support, responses for users, maintaining a

professional workforce, and to maintain data transparency (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2022b).

Emphasis for adaptation to increase development and acquisition speed is further seen in DoDI 5000.02 Operation of the Adaptive Acquisition Framework which comes from the Under Secretary of Defense for Acquisition and Sustainment, and predates DoDI 5000.01 with its initial release on 23 January 2020 and a small update on 8 June 2022. This instruction provided a substantial update from earlier practices by implementing multiple acquisition paths and frameworks with the policy ultimately hoping to yield "technological innovation and a culture of performance that yields decisive and sustained…advantage" (p. 4) (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2022a). Expanding beyond the previous Major Capability Acquisition, the new frameworks enable six different suggested paths to acquire capabilities and go further for enterprise and service-based solutions with an emphasis on security, tailoring, and empowering managers with flexibility (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2022a). The frameworks still suggest and require milestones (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2022a), but can now provide increased flexibility which promotes innovation. The enterprise and service pathways further enable newer support services, software, etc., to enable efficiency and promote smart enterprise solutions which are essential for agile products; iterations and continuous assessment are also specifically seen in these pathways too. Each pathway, shown in Figure 4, also received its own policy guide (Defense Acquisition University, 2024a).

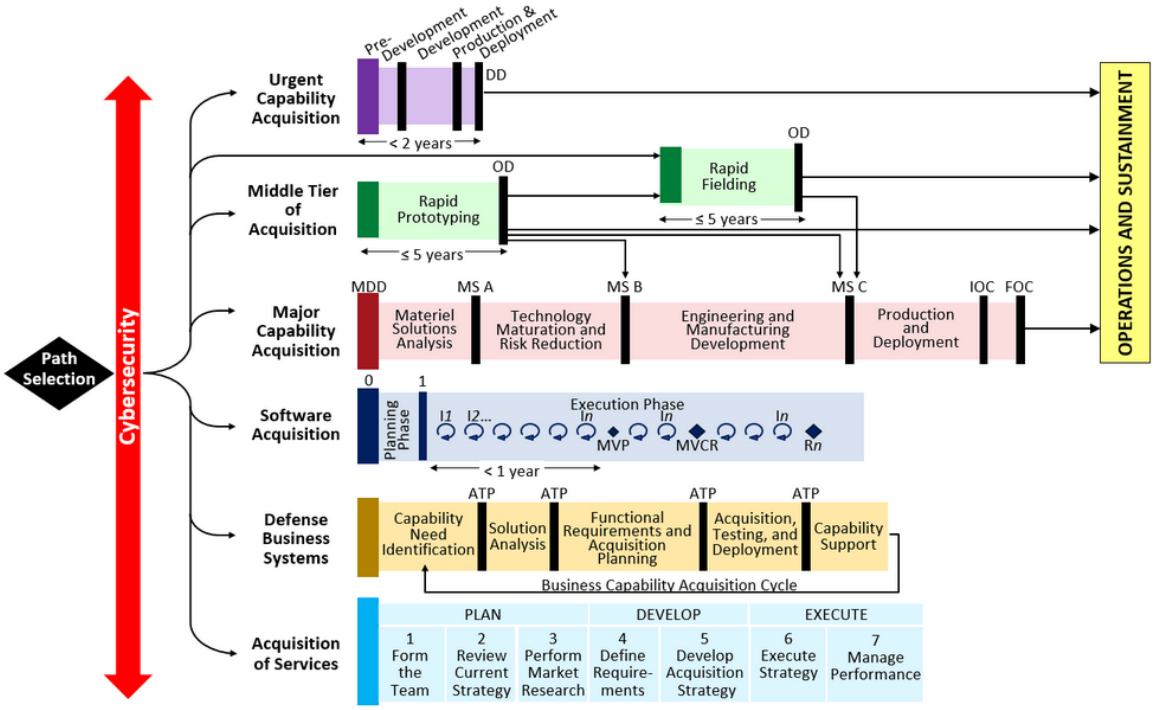

Figure 4. Adaptive Acquisition Pathways. Source: Office of the Under Secretary of Defense for Acquisition and Sustainment (2022a)

One element that still impacts the execution of DAS is the Planning, Programming, Budgeting, and Execution (PPBE) process. Out of this congressionally mandated process comes an annual and an overall five year budget and plan for the DoD and its projects (Defense Acquisition University, 2024d). This process, along with the budgets and allocations that are ultimately provided by Congress, do not always align with acquisition plans and rarely align with joint or urgent needs that pop up outside of the standard planning and execution cycles (Government Accountability Office, 2015, 2021). Continuing Resolutions (CR) have become common place resulting in major impacts to actual funding needs especially for new projects or programs (Government Accountability Office, 2021). These misalignments result in funds being partially received or received late with the same expectation that the full amount can be executed with a much shorter timeline, and because of the limitations or restrictions with funding types, a tighter timeline to execute (Government Accountability Office, 2021). While larger, multi-year programs that fall within the PPBE are less likely to be impacted, new and smaller programs can absolutely

expect an impact as they will not be able to start, or will have funding paused to support the larger, capital projects (Government Accountability Office, 2021). This impact, while only for a few weeks or months in the CR, typically has a much longer impact as contract timelines and execution, reallocation of resources, other external supporting elements, etc., all have to be restarted while also dealing with an large influx of late funding to push out the door (Government Accountability Office, 2021). Since innovations are typically new ideas or solving a new and quick problem, the budget reality of a CR and the larger PPBE process is a large and immovable obstacle.

2. National Defense Authorization Act

A National Defense Authorization Act is

> An Act to authorize appropriations for fiscal year…for military activities of the Department of Defense and for military construction, and for defense activities of the Department of Energy, to prescribe military personnel strengths for such fiscal year, and for other purposes. (NDAA, 2023, p. 2)

Each year, Congress must authorize funds through authorization acts and appropriate funds through appropriation acts to enable the DoD and other governmental organizations to operate. For the DoD, the NDAA provides the authority for programs, establishes priorities, and provides direction on what it should be executing. The act is developed from an initial budget from the Executive branch and fully developed through committees which solicit feedback and expertise from military, civil, and academic leaders. It aligns with the *National Defense Strategy* and multi-year plans which include a roll up of all the PPBE plans through the DoD's request for funding, allowing Congress to dictate policy, efforts, and investments by what they fund, what they require, and to what degree they desire. For example, establishment of the DIU, DIB, etc., and their continued operation is authorized by the NDAA and funded by the Defense Appropriation Act. Each NDAA from Fiscal Year (FY) 2020 through 2024 has been approximately 900 pages and authorized $738 billion in FY20 (NDAA, 2019) to $1,075 billion in FY24 (NDAA, 2023), making this document one of the longest documents produced by Congress each year.

With a focus on innovation, multiple searches of each NDAA between FY20 and FY24 reveals a few trends, shown in Table 1.

Table 1. NDAA Search and Analysis. Adapted from (NDAA, 2019; NDAA, 2021a; NDAA, 2021b; NDAA, 2022; NDAA, 2023)

NDAA Version	FY2020	FY2021	FY2022	FY2023	FY2024
PDF Pages	1,120	1,482	910	1,772	974
Word Count	498,798	647,282	403,502	782,264	430,430
Search “innovation”	145	144	67	120	90
Search “innovate”	1	0	0	2	0
Search “warfare”	76	80	138	159	123
Search “warfare center”	0	0	34	41	8
Search “surface warfare center”	0	0	20	17	2
Search “south potomac”	2	2	0	0	0
Search “dahlgren”	0	0	2	3	0
SEC. 4601 FY Request for Military Construction for “surface warfare center”	$ -	$ -	$ -	$ -	$ -
SEC. 4601 Conference Authorized for Military Construction for “surface warfare center”	$ -	$ -	$78,790,000	$133,016,000	$65,200,000

Using Foxit PDF Reader Version 11.0.0.49893 and PDFs found in References.
Search conducting without case-sensitive, and allowing partial words

A raw search from FY20 – FY24 shows 145, 144, 67, 120, and 90 mentions respectively, or a slight decreasing trend and seemingly decreasing interest in funding innovation (NDAA, 2019; NDAA, 2021a; NDAA, 2021b; NDAA, 2022; NDAA, 2023). However, the context is much more important and shows both learning and shift of policy. In FY20, the mentions focused on the DIU expansion and reorganization, funding research into acquisition innovation, and both established or expanded several other initiatives like the Business Innovation Research Program, Regional Innovation Initiative, and Manufacturing Innovation Program; 10 boards or innovation programs were funded through budget line items (NDAA, 2019). By FY2024, the NDAA continues to expand emphasis on innovation with multiple organizations and boards being codified, direction given to leadership to include these boards in decisions, and the establishment of more innovation groups like the Intelligence Innovation Board while including 17 budget line items specifically funding innovation boards and initiatives (NDAA, 2019; NDAA, 2021a; NDAA, 2021b; NDAA, 2022; NDAA, 2023). The NDAA FY24 authorized $314 million

in funding for "innovation" related activities, with DIU receiving $109 million (NDAA, 2023). Thus, Congress and the DoD are very interested in increasing innovation practices, education, and acquisition.

With a focus on the Warfare Centers, several searches with keywords were conducted with specific focus toward identifying Naval Surface Warfare Center direction or funding activities, as shown in Table 1. While "warfare" is mentioned a number of times in each NDAA, actual representation or funding for the Naval Surface Warfare Centers were limited to zero for FY20 and FY21 (NDAA, 2019; NDAA, 2021a); seventeen mentions in FY22 were for military construction projects with all but one item being zeroed or not funding any actual construction and all efforts were not asked for in the requested budget (NDAA, 2021b); twelve mentions in FY23 for military construction projects with one line funded for a Data Science Analytics and Innovation facility at NSWC Corona for $2.8 million, but all were again $0 requests (NDAA, 2022); and one mention in FY24 to ensure NAVSEA is part of an additive manufacturing consortium (NDAA, 2023). Searching "south potomac," referring to the Naval Support Activity at Dahlgren, the largest of the Surface Warfare Centers, revealed a mention once in 2020 and 2021 for a potable water upgrade, and none in other years, as shown in Table 1. These findings are in sharp contrast to the "innovation" findings, begging the question of how the Navy and other Services actually view the Warfare Centers and their importance to innovation.

C. ENTITIES TO COMPARE

Recognizing that it is slow to change and desiring to be more adaptive to the emerging threats, the DoD and Congress created two entities specifically geared toward informing and executing innovative ideas: the Defense Innovation Board (DIB) and the Defense Innovation Unit (DIU).

1. Defense Innovation Board and Defense Innovation Unit

> The Defense Innovation Board is chartered with the authority and responsibility to provide independent, practical, and actionable recommendations to the Secretary of Defense and other Department leaders on catalyzing innovation in the Department to strengthen our national

> security and future-proof our warfighting capabilities. (Defense Innovation Board, 2024a, p. 3)

The DIB has been led by a number of notable leaders including Michael Bloomberg and Michael Mullen (ADM ret.) who act as an advisory committee to try to solve one very important problem in the DoD: how to innovate (Defense Innovation Board, 2024a). Started in 2016 by the Secretary of Defense (Defense Innovation Board, 2016), this board has conducted a number of studies and sessions with DoD leaders to identify gaps, roadblocks, and other detriments that limit innovation and innovative thinking for the services (Defense Innovation Board, 2016, 2024a, 2024b). DIB recommendations are partially responsible for the DoD 5000 reformation that happened in 2020 (Ferinando, 2017). The board has continued to grow as seen by its budget growing from approximately $600,000 in 2016 to nearly $2 million in 2024 while its duties have also expanded from providing "independent advice and recommendations on innovative means" to now also examining commercial best practices, evaluating some technologies, organizational structures, and decision making practices for the DoD with several specialized subcommittees, papers, and other products (Defense Innovation Board, 2016, 2024b).

In one of their latest studies "Lowering Barriers to Innovation," the DIB notes that the DoD has made great strides by establishing a number of initiatives, offices, policy papers, and realignments with some funding going toward each to enable then to execute (Defense Innovation Board, 2024a). However, it is obvious that while new things have been added and that some of the policies should enable places like NSWC to also restructure, there's little useful progress toward changing the DoD culture or actually causing change at places like NSWC. The board notes:

> despite these critical efforts, defense innovation remains hampered by the intricacy of our defense structure, arguably the world's most complex business enterprise. This tangled system, influenced significantly by external forces, stakeholder pressures, congressional oversight, federal regulations, and suboptimal procurement processes, hinders rapid adoption and ultimately, implementation of new systems.(Defense Innovation Board, 2024a, p. 6)

Recalling from the previous sections the key elements to execution of an innovative idea (the innovation itself, expected impact of the innovation, cost, schedule, risk,

leadership acceptance, and customer/warfighter acceptance), the DIB's seven consolidated findings reveal continued troubles at core areas:

1. Leadership: Leaders continue to practice status quo resulting in slow implementation or lack of support/buy-in to middle and junior leaders wanting to take risks

2. Security: Changing and misunderstood needs and requirements without an authority to move across departments or services by any entity; lack of facilities needed to properly support these needs and users; and complicated, slow, and overwhelmed personnel vetting which adds excessive delay

3. No Continuous Authority to Operate (ATO) Strategy: DoD is mandating agile development environments but is failing to scale development environments able to support the requirement

4. Contracting Processes: The current structure is too complex with many rules, policies, and requirements that force excessive effort by bidders; and contracts fail to require proof of product or product capability while also limiting government data rights which result in poor performance and vendor lock

5. Misaligned Government and Commercial Processes: DoD does not utilize common industry practices, has complicated contracting practices and requirements, and is unclear in its funding expectations causing large or insurmountable barriers for small businesses and other commercial entities to enter the DoD's contractor and vendor pathways

6. Enterprise License Agreements Through a Single Entity: Consolidation of enterprise software has resulted in large awards to minimal entities thus reducing competition; specific user needs require waivers and unique packages which increases cost and adversely impacts their schedules; and

enterprise security and enforcement creates additional user challenges for unique needs

7. Dual-Use (Commercial and Military) Technology Implementation: DoD desires commercial-off-the-shelf technologies to leverage for cost effective, speedy partial solutions, but then typically imposes extensive requirements to vendors to integrate their products directly into military systems, resulting in a specific product unlikely to meet the full need or intent, vendor lock, supply chain issues, and lack of agility (Defense Innovation Board, 2024a)

The DIU builds off of the DIB recommendations and provides an execution arm that defines the need for innovation for the DoD in its driving principles to maintain both competitiveness and effectiveness on the battlefield.

> In the face of rapidly evolving threats and operating environments, the DoD must continuously inject innovative solutions into its strategy and operations to maintain critical advantage on and off the battlefield. Peer and near-peer competitors are challenging U.S. primacy across a number of domains and technologies, and (the)DoD must navigate shifting economic and industry environments to meet these challenges and achieve mission success. (Defense Innovation Unit, 2024a)

The DIU is led by the DIU Director and run by a combined board of industry and retired military leaders (Defense Innovation Unit, 2024c). DIU approaches innovation by evaluating commercial products that could be militarized or are usable as-is in a 12-to-24 month (or shorter) period, and largely provide recommendations to program offices to enable them to pick up and transition a useful military product (Defense Innovation Unit, 2024b). To expedite effort, the unit primarily uses other transaction authorities to provide funding in as little at 60 days to a contractor or commercial entity to develop and demonstrate their capability against the desired gap prior to program office transition. (Defense Innovation Unit, 2024b)

2. Joint and Service Specific Program Offices

Moving away from the DoD specific innovation entities, the more prevalent and typical acquisition entities are program offices, which oversee and execute multiple programs either specifically to a military Service or with Joint Services where a single office or multiple offices will be involved. The offices follow the DAS and associated framework with program managers and their team ideally tailoring an acquisition approach best suited to procure and sustain the capability they are tasked to deliver (Defense Acquisition University, 2004). Service-centric efforts maintain control and acceptance with just their service leads, while joint-centric efforts take on a much more extensive approval and oversight overhead (Defense Acquisition University, 2004). Typically, a single Service will take lead in the execution of a joint effort, but each associated Service will also provide approval of the execution, requirements, and other key program attributes; efforts being jointly lead through multiple program offices become much more complex, slower, and more complicated (Defense Acquisition University, 2004). The addition of the approval and review overhead often adds more cost, extends schedules, and results in more risk for execution of the effort; and will often take on a much more complicated product requiring unique service-specific configurations and certifications as no service has the same certification processes or wants to pay for the deltas required by the other services to suit their unique and specific needs. (Defense Acquisition University, 2004)

3. Naval Surface Warfare Center Dahlgren

NSWC Dahlgren is part of the Naval Sea Systems Command (NAVSEA) and is the largest Warfare Center with nearly 5,000 personnel, a typical budget around $2.3 billion with an additional $1.2 billion in contracts, and the most technical capability areas (Naval Sea Systems Command, 2023b). The center has had an extensive research and development history with several transitions since its inception in 1918 as a naval gun range and proving facility (Naval District Washington, 2024a) to including a Panama City, Florida detachment devoted to mine, amphibious, and expeditionary warfare in 1992 before it became its own Naval Surface Warfare Center in 2007 (Naval Sea Systems Command, 2024b). Dahlgren has been home to the creation of multiple naval gun weapon systems;

shipboard and aircraft targeting systems; and even missile and space based systems like the Tomahawk Missile and the Global Positioning System (Naval District Washington, 2024a). Dahlgren contained the Navy's world-renowned Chemical and Biological Program with very unique and specialized facilities (NSWC Dahlgren Public Affairs, 2002) that developed the revolutionary Dahlgren Decon agent able to neutralize a large variety of toxic and harmful agents (Dyson, 2018). However, as mission needs change so too must development facilities. To make room on the sparsely developed 4,000 acre campus (Naval District Washington, 2024a) for future energy and cyber, the Chemical and Biological Program was essentially disbanded to move to NSWC Indian Head in 2018 with no supporting facilities in a rather confusing announcement to the public (Dyson, 2018). An opinion piece by the Dahlgren Technical Director and Commanding Officer stated this mission realignment was a national level decision, that the effort was not a bailout for NSWC Indian Head, funding in years after 2018 would provide for updated facilities at Indian Head and Dahlgren, and that employees were well notified of all the plans (Fiore & Weekes, 2018). However, this narrative does not match both employee perspectives (Dyson, 2018) nor funding in out years for this mission realignment and formation of the new energy and cyber missions and the unique facilities needed (NDAA, 2019; NDAA, 2021a; NDAA, 2021b; NDAA, 2022; NDAA, 2023). Follow-on realignment did however place a new Dam Neck Activity already at Naval Air Station Oceana's Dam Neck Annex under Dahlgren 2020 (Naval Sea Systems Command, 2024d). The Dam Neck Activity has its own chain of command, thrust areas, and mission statements that differ from its parent NSWC Dahlgren as shown in Table 2.

Table 2. NSWC Dahlgren Verse Dam Neck Activity Strategic Thrusts, Mission, and Vision Statements

	NSWC Dahlgren Strategic Thrusts, Mission, and Vision		Dam Neck Activity Strategic Thrusts, Mission, and Vision
Thrust 1	Intelligent Automation	Integrated Combat Power	Intelligence & Cyber Technology
Thrust 2	Software Engineering Revolution	Hypersonic Weapon Systems	Integrated Training Systems
Thrust 3	Digital Engineering	Intelligent Automation	Combat Systems Readiness
Thrust 4	Hypersonic Weapons Advancement		Science & Technology
Thrust 5	Information Superiority		
Vision	Design, develop, and integrate technologically superior, 21st century warfare systems	No peers, no fear	Defeat all current and future national threats with cyber resilient tactical and training systems fortified with exemplary fleet readiness.
Mission	We deliver warfare systems to protect our nation and defeat our adversaries	Develop and deliver weapon systems to detect and defeat our adversaries	To be a recognized R&D and Engineering National leader developing innovative, affordable, and effective threat-driven integrated training systems, cyber warfare, fleet readiness and sustainment solutions for the Naval Warfighter.
Source	(Naval Sea Systems Command, 2021)	(Naval Sea Systems Command, 2024a)	(Naval Sea Systems Command, 2024d)

Naval Support Facility (NSF)/Naval Support Activity (NSA) Dahlgren, part of the larger Naval Support Activity South Potomac, hosts NSWC Dahlgren (Naval District Washington, 2024d). The activity has its own command structure and support elements led by a Captain/O-6 (Naval District Washington, 2024b) and is responsible for the facilities and grounds with a fairly simple vision and mission to essentially sustain the installation for readiness and to provide both effective and efficient installation management (Naval District Washington, 2024c).

Established on 3 November 2005, NSF Dahlgren actually hosts more tenants than NSWC Dahlgren, which can often confuse visitors: Naval Surface and Mine Warfighting Development Center Dahlgren, Sea-Based Weapon Systems, Center for Surface Combat Systems, AEGIS Training and Readiness Center, Joint Warfare Analysis Center, and the

18th Space Control Squadron Det 1 (Naval District Washington, 2024d). Each of these tenants have their own security processes/procedures, facilities, regulations, and rules; a few even have their own computer and network systems. New requirements or needs of any of these tenants must first pass through their appropriate chain of command, and then also through NSF Dahlgren.

Trying to understand NSWC Dahlgren's vision and mission, which should help align its workforce in purpose and direction, can be confusing as shown in Table 3.

Table 3. NSWC Dahlgren's Current Vision and Mission Statements

	Command's website (2024)	2021-2025 Strategic Plan	2024 Strategic Direction
Vision	Our vision is to be the Navy's trusted partner for identifying and providing innovative cost effective technical solutions to the warfighter. We will be responsive to the Navy Enterprises, the Joint Force and national requirements, while partnering with industry, other DoD laboratories, and academia	Design, develop, and integrate technologically superior, 21st century warfare systems	No peers, no fear
Mission	The Naval Surface Warfare Center (NSWC) cohesively and seamlessly operates the Navy's full spectrum research, development, test and evaluation, engineering, and fleet support centers for offensive and defensive systems associated with surface warfare and related areas of joint, homeland and national defense systems from the sea	We deliver warfare systems to protect our nation and defeat our adversaries	Develop and deliver weapon systems to detect and defeat our adversaries
Source	(Naval Sea Systems Command, 2024c)	(Naval Sea Systems Command, 2021)	(Naval Sea Systems Command, 2024a)

Confusion also lies in the Warfare Center's key strategic thrusts, which should govern most investments and work activities plus align with high level needs as shown in Table 4.

Table 4. NSWC Dahlgren's and Dam Neck Activity's Current Strategic Thrusts

	NAVSEA: NSWCDD Thrusts	NSWCDD 2021–2025 Strategic Plan	NSWCDD 2024 Strategic Direction	Dam Neck Activity Strategic Thrusts
Thrust 1	Lead electric weapons development	Intelligent Automation	Integrated Combat Power	Intelligence & Cyber Technology
Thrust 2	Institutionalize mission engineering and analysis	Software Engineering Revolution	Hypersonic Weapon Systems	Integrated Training Systems
Thrust 3	Incorporate cyberwarfare into naval systems	Digital Engineering	Intelligent Automation	Combat Systems Readiness
Thrust 4		Hypersonic Weapons Advancement		Science & Technology
Thrust 5		Information Superiority		
Source	(Naval Sea Systems Command, 2023b)	(Naval Sea Systems Command, 2021)	(Naval Sea Systems Command, 2024a)	(Naval Sea Systems Command, 2024d)

NSWC and NSF Dahlgren operate under the Navy Capital Working Fund Research and Development and Facility activity groups respectively which is funded by a congressional direct appropriation. All Warfare Centers share this fund, which includes a carryover that can last for months; thus, during a continuing resolution or other government budget struggles, the Warfare Centers and their facilities remain open and operational when other agencies close as long funding remains in the fund (Department of the Navy, 2009). However, groups and programs sponsored by other sources like program offices, other military Services, or other agencies will likely be impacted if the sponsor, comptrollers, and financial managers have not transferred funding to cover requirements. Most efforts at Dahlgren operate with research, development, test, and evaluation (RDTE) funds which are active for two years from the appropriation date, but may also operate under three year procurement or one year operations and maintenance (O&M) funds which are both only active for one year. Each funding type has its own limitations and, by the nature of an appropriation, a set of specific purposes and uses (Defense Acquisition University, 2024f).

4. Elon Musk's Starlink/Starshield

Moving away from DoD entities, this literature review presents an overview of two successful DoD industry partners who continue to provide program support, create or are tasked to create new capabilities, and who employ some of the latest and greatest innovative capabilities both for the DoD and for their industry. Starlink and Skunk Works will be rolled into a combined Innovative Commercial Entity during the comparison scoring.

Few, if any, companies have jumped into an existing industry, completely re-written the existing rules of business, made a traditionally expensive service or product at a reasonable cost, and effectively changed the outcome of a war with a major superpower in less than ten years of starting up. Elon Musk's Starlink has and is thus a unique company. While the technology to create a satellite telecom capability has existed for many years, nobody was able to affordably setup and manage a constellation and much less able to have the constellation rival earth-based wired and wireless providers in speed, latency, and reliability (Dans, 2021). Starlink planned and received approval in 2014 for a robust 42,000 node constellation in low earth orbit, launched satellites starting in 2019 at a pace of roughly a rocket launch a week with 60 satellites per load, and started providing data services in early 2021; by September 2022, more than 3000 satellites were in operation (Erwin, 2024). Many of the first U.S. customers were underserved or remote areas who had no options and disaster areas, resulting in multiple good news stories about this amazing new capability (Tripathy, 2022). This timeline is not uncommon; a study of U.S. Government satellite programs revealed a similar average of 7.5 years from contract approval to launch though this timeline did not always include technology development and maturation to be space ready (Davis & Filip, 2015); but the magnitude of production and orbital deployment, further at a significant cost reduction thanks to parent company SpaceX's rocket development, is unique (Erwin, 2024).

Further success and unique capabilities were seen when Russia invaded neighboring Ukraine in February 2022. Ukraine's telecoms were primary targets for the invader and communications in the country were heavily decimated in early strikes and by occupation forces (Bergengruen, 2022). Starlink service was activated over Ukraine

roughly ten hours after Russia invaded and a multi-shipping container delivery of Starlink terminals arrived less than two days later, giving Ukraine the capability to setup communications for their military and infrastructure (Tripathy, 2022). By April, or roughly two months later, more than 50,000 terminals were in Ukraine with Starlink footing most of the bill (Tripathy, 2022). Russia, being a near-peer competitor to the United States with extensive jamming and cyber capabilities were thwarted continuously on their attempts to degrade or jam Starlink signals and terminals, which is uncommon for a commercial entity (Petkauskas, 2022). The system, designed with a development, security, and operations (DevSecOps) framework; software defined radios; and other unique capabilities, stood up to and continues to overcome any Russian attempts at degradation (Petkauskas, 2022). Thus, Ukraine was able to maintain communications and coordination with their armed forces (Petkauskas, 2022).

Starlink, thanks in part to SpaceX and their Falcon 9 rockets has a unique advantage: the cost to deliver payloads to space is significantly cheaper thanks to Falcon 9 efficiencies and reusing space craft, boosters, and other previously unusable assemblies (Tripathy, 2022). Government spacecraft and other payloads prior to SpaceX could plan on each pound costing $30,000 or more to take into space, and early commercial attempts reduced this to around $10,000 per pound; SpaceX has significantly reduced this further to around $1200 per pound (Chow, 2022). This delivery cost reduction is significant when trying to establish a constellation (Tripathy, 2022). The other major advantage is the low cost, small size, and highly producible design of the Starlink satellites that come in around $200,000 each for their first generation (Erwin, 2024). This combination of reduced launch and satellite cost has translated to cheap and affordable satellite network service that is robust and reliable, attracting large numbers of private and government customers, and culminates in a projected positive cash flow and revenue in 2024 for Starlink (Erwin, 2024). Starlink also applied for and used a number of government grants and subsidies to offset development and production costs, which also added requirements like a DevSecOps approach and has allowed them to seamlessly work with the U.S. Government and other allies for a more capable system operating on the same network known as Starshield (Tripathy, 2022). The combination of a strong vision with a strong business case, mass

production centric design with cost savings, integration of the latest and multiple commercial technologies, and an emphasis on speed has allowed Starlink to reshape the satellite internet world while also bringing the capability into an affordable cost for the everyday consumer all over the world (Dans, 2021; Erwin, 2024; Tripathy, 2022).

5. Lockheed Martin's Skunk Works and Kelly Johnson's 14 Rules

World events, especially a world war, provide a unique incentive to be innovate, allow leadership to bypass their typical rules, and opens doors that would typically never open in order to gain a capability, or in this case, catch up to an adversary's capability. Britain had been working on their first jet aircraft since 1940 with a test flight in April 1941 that showed off a unique plane and even more unique engine, but a design that needed a lot more work especially to be producible in quantities for the war (Wilkinson, 2021). Bell and General Electric (GE) were awarded a contract to design the P-59 Airacomet, but by 1943, the design had no benefit over propeller driven aircraft (J. Miller, 1995). Lockheed had a design called the L-1000 designed by Nathan Price, but for multiple reasons, was asked to instead focus all efforts on their current production and improving the P-38 Lightening (J. Miller, 1995; Wilkinson, 2021). This design would turn out to be a huge advantage for Lockheed and an upcoming challenge (Wilkinson, 2021). In spring of 1943, the German Me-262 completely changed that aircraft game as this first real jet became the king of the skies; and the allies had no answer (Wilkinson, 2021). On 8 June 1943, Clarence "Kelly" Johnson pitched his idea to General Frank Carroll along with a promise to have a prototype ready in 180 days; the General bit on the spot and the clock started (Lockheed Martin, 2024b; J. Miller, 1995).

With no facilities available and no team, Kelly's first task to was to setup a facility and with the blessing of his management, to hand pick a small team of engineers, mechanics, and other tradesmen to support their effort (Lockheed Martin, 2024b; J. Miller, 1995). Back in Burbank, CA, a large circus tent was setup (Agle, 2014) while his team of 128 personnel (Agle, 2014; Wilkinson, 2021) gathered materials, started reviewing drawings, and setup agreements with local machine shops to start getting tooling and support needed (Agle, 2014). They also received two British jet engines while GE was

working on a new I-40 engine that would be of similar size (Agle, 2014). The development pace was extreme as were the conditions of their makeshift facilities, but on 8 January 1944, just short of their deadline, the Lulu Belle took off on its maiden flight (Agle, 2014). On the next day, the test pilot Milo Burcham opened up the aircraft's capabilities, buzzing the airfield at 475 miles per hour (Agle, 2014) and forever changing American aviation. Three weeks after this flight, the new GE engine was installed adding even more speed and power, and the Army ordered 500 P-80As before the new setup even took flight (Agle, 2014). The success of this group, called the Skunk Works after their crazy circus setup and its resembled a cartoon, was forever solidified (Agle, 2014).

The gaps and needs for new designs and radical innovations did not stop when the world war did; instead, a whole new technological war and arms race, the cold war, with the Soviet Union kicked off. With the success and blessing of the military and other three letter agencies, the new Skunk Works division was tasked to create whole new aircraft that would push all boundaries, kick off their own technological challenges, and ultimately provide America with far superior capabilities (J. Miller, 1995). Even after the cold war, this same group continued to innovate, creating the U-2 Dragon Lady spy plane, the supersonic predecessors A-12 and SR-71 along with a supersonic D21 drone, the stealth F-117, the YF-22 or precursor to the current F-22 Raptor, the X-35 or now the F-35 Joint Strike Fighter, and a plethora of other aircraft (Lockheed Martin, 2024a, 2024b, 2024c).

Kelly Johnson, who led and then consulted at his Skunk Works group for more than 40 years, put forward fourteen rules for innovation and execution success (J. Miller, 1995), which are still used today (Lockheed Martin, 2024c). These fourteen rules, shown in Figure 5, will also be used as a second comparison metric to score our entities against to provide another innovative measure and to understand how our entities would align against industry capabilities.

Figure 5. Kelly Johnson's 14 Rules. Source: (Johnson, 2014)

D. ADDITIONAL BACKGROUND INTO INNOVATIVE THINKING, DOD ACQUISITION PROCESSES/TRAINING, AND DOD PROCESS IMPROVEMENTS

This section provides additional information and insight into workforce training, education, execution reviews, and high-level assessments of the DoD to establish a frame of thinking for execution and creative employees while also showing a pace to change for the DoD. These elements are important to provide both effective innovation and execution of that innovation against new needs or threats. This background also provides examples of some uncommon or unique innovative successes with comparisons to typical processes, showing that innovation is both executable and possible, even if uncommon within the DoD. These elements further provide improvements that are needed or are being worked on now to continually improve the DoD's innovative efforts, and contributes to this research project.

1. Defense Acquisition Workforce Improvement Act and the Defense Acquisition University

The Defense Acquisition Workforce Improvement Act and associated Acquisition Corps was established into law in 1990 to establish a set of standards of education for DoD acquisition personnel to ensure they are informed about the many requirements, rules, regulations, and operating principles behind designing, building, and maintaining the DoD's weapon system and other acquisitions (DAW 2018 Edition with Supplement V, 2024). This act and the DoD established a set of roles and responsibilities, an extensive training regimen with continuous learning requirements for all acquisition personnel including contractors in certain roles, specialized requirements for certain positions which further mandated specific job requirements, a training cadre including the Defense Acquisition University, and even an rewards system; all of this ensure the DoD was actively practicing good acquisition practices (DAW 2018 Edition with Supplement V, 2024).

Innovation, its recognition, and its practices have not been a focus in training the acquisition workforce until recently (DAW 1994 Main Edition, 1995; DAW 2018 Main Edition, 2019). This implies that innovative practices were not widespread or well

understood by the workforce as a whole (DAW 1994 Main Edition, 1995). As an example, performing a search in April 2024 of the DAU.edu website for innovation or variations of the word result in a total of 1846 references which is extensive compared to other topics, like PPBE; however, content for actual innovation initiatives or applications of innovation were lacking as the search is picking up on just the word itself. A better comparison lies in looking at established courses of which seven contained innovation or its variations in their description: EXE 4050, CON 0120, WS013, PMT 4020, ALD 0160, WSD006, WSD 022, ALD 0100, ALD 1100 (Defense Acquisition University, 2024g). Of these courses, only one actually contains any reference to innovation or variations of the word being effectively taught: EXE 4050 – Leading Change to Drive Innovate Culture; this course is a senior level, five day course that was first offered in July 2020 (Defense Acquisition University, 2024b). In contrast, PPBE is taught specifically in seven courses from entry level to senior level (Defense Acquisition University, 2024e).

In 2023 through, recognizing that innovation is more than just a word and an actual recognition of effort and action, the DAU stood up the Innovate to Win web series and is looking to expand upon the topic, research for improving innovative thinking and implementation of innovation initiatives, and ultimately workforce improvement (Defense Acquisition University, 2024c). The DAU is presently trying to establish a Innovation Competency Model to assess readiness, skills, and other key elements needed to promote innovation and its implementation (Defense Acquisition University, 2024c). DAU is also trying to bring together personnel, researchers, and acquisition professionals, as seen by its devoting the July-August 2023 issues of the Defense Acquisition Magazine to innovation (Defense Acquisition University, 2023). Two articles within this magazine speak specifically to innovation and the DAS.

The article *Disruptive Innovation – Time to Rethink "Big A" Acquisition* delves into innovation and how it can be thought of in two paradigms: disruptive and sustaining. In the DoD, the constant churn and creation of new solutions to new gaps or needs is a sustainment action while something like Netflix, which completely redefined home entertainment, is seen as a disruptive innovation. Schultz (2023) makes an argument that the current DoD acquisition processes focus on and incentivize sustained innovation

largely because of the processes like PPBE, the Joint Capabilities Integration and Development System (JCIDS), and even DAS are large, very bureaucratic, and exceptionally slow. While he notes that the DoD appears to be moving in the right direction with the rework of the Adaptive Acquisition Framework in 2020, the other parts of "Big A" continue to hold up progress and need extensive rework to provide the flexibility needed to allow the DoD to be more disruptive capable (Schultz, 2023).

> The conflict in Ukraine demonstrates how innovation can rapidly overcome traditional tactics. A few examples are the use of many types of unmanned aerial systems in combined arms, software packages developed by volunteers, and Starlink for high-speed internet to overcome jamming. While innovation is occurring throughout the DoD, significant institutional barriers continue plaguing adoption of innovative technologies into our warfighting capabilities. (Schultz, 2023, p. 24)

Ukraine, with a lack of any effective Navy, has shown the world how taping explosives to a remote controlled jet ski and using Starlink can effectively defeat the once famous Russian Black Sea Fleet (Ankel, 2023); a rather simple but clearly effective innovation that our Navy still has yet to master after many years and millions in investment.

The article *Closing the Innovation Gap by Rethinking Defense Acquisition Education* emphasizes a need for a more dynamic and agile continuous educational model that goes beyond just course work and emphasizes real-life scenarios and modeling enable students to experience what they learn. The Naval Postgraduate School (NPS) has also teamed with DAU to roll relevant coursework and knowledge into several advanced degrees, thus aligning DAU principles of acquisition with more advanced leadership, decision making, and simulated learning environments to both equip tomorrow's acquisition leaders, but to also give them agility to expedite acquisition decisions (Mortlock & Jones, 2023). Enabling students to both interact with real warfighters, immerse into real simulation environments, and to share or gain experiences will enable the future leaders to be more effective, but also provide a future model for DAU coursework with a more practical, useful, and applicable learning experience for the acquisition workforce (Mortlock & Jones, 2023).

2. Section 809 Panel

The panel, originally formed by the FY 2016 NDAA, was established to review acquisition regulations, rules, and instructions for roadblocks or other red tape that has been slowing down or preventing acquisition efforts by the DoD; and to further provide recommendations to make our acquisition system more effective, flexible, and in-line with best practices outside of the DoD (Defense Technical Information Center, 2024). The panel, disbanded in July 2019 per its congressional authorization, produced a series of reports over its almost three year life with 93 recommendations (some of which had multiple parts) to transition DoD's acquisition to be more effective and agile; mentioned "innovation" 403 times with an extensive recommendation to establish a Center for Acquisition Innovation; and ultimately provided smart suggestions with its panel of retired generals, admirals, and other leaders to improve acquisition (Defense Technical Information Center, 2024). Arguably, suggestions like 21C to "enable innovation in the acquisition system" helped to push newer initiatives like the DoD 5000 updates to an adaptive framework; while other suggestions like 50 to "enact regular appropriations bills on time" or 54 to "permit the initiation of multiyear procurements under a CR" have essentially been ignored (Section 809 Panel, 2017, 2018a, 2018b, 2019a, 2019b).

Innovation, and by association the Warfare Centers or previous labs who led the development of some of the new technologies for the DoD, are very important to staying relevant to a military. The 809 interim report notes that technology in warfare is largely stagnant or consistent with the occasional burst thanks to an innovation leading to new platforms and capabilities like the transition from sailing ships to ironclads, battleships to carriers, and muskets to rifles (Section 809 Panel, 2017). There's also an element that whichever country or military was able to quickly and effectively adopt, procure, train, implement, and maintain the new technology gained a superior edge to their peers; acquisition systems though sometimes struggle with this adaptation and are generally tailored toward consistent and predicable development (Section 809 Panel, 2017). As time has marched on, this pace of change has steadily increased with an example of computer storage being given where the first computers in the 1950s stored approximately 3.75 megabytes with a one ton, 5 foot by 6 foot cabinet (Computer History Museum, 2018); by

the 1980s or in 30 years, a 3.5 inch floppy disk would store 1.44 megabytes; and in the 2010s or another 30 years USB drives could store over a terabyte; not to mention the cost scaling or huge increases in speed, life, and other capabilities (Section 809 Panel, 2017). In recent years, new innovations in computing power, software languages, miniaturization, etc., have both accelerated the pace of change and are redefining what successful development and integration look like as other countries, like China, have been early and quick adopters of the new technologies (Govini, 2021).

> Systems and capabilities must be developed, deployed, and integrated into operations within the arc of the threat, not after the threat has passed or after DoD has spent billions of dollars on technologies or capabilities that already are obsolete or will be obsolete by the time they are deployed. The private sector now drives much of the technological innovation, which makes it difficult for DoD to keep pace. (Section 809 Panel, 2017, p. 8)

The 809 panel recognized another important trend that is affecting the DoD: a changing marketplace. As the statement above points out, the DoD is no longer a driver in the marketplace, and again the 809 interim report points out that the DoD purchased more than 90% of the U.S.'s semiconductors, but is now responsible for less than 2%; and this trend holds true for many other components too. This trend also reflects a diversification by companies, especially as the defense industry has increasingly dwindled in size with companies buying up competitors or capabilities to add to their portfolio and the DoD itself no longer being a principal buyer compared to other markets. Diversification of the supply chains globally has further shifted the market and complicated acquisition. Some reason for this change could also fall on the decreasing ratio of research and development (R&D) by the DoD, who once commanded 49% of R&D in the United States, but now only contributes to 16% (Section 809 Panel, 2017); yet more credence why commercial entities are driving capabilities. There is also a disturbing trend where adversaries are greatly increasing their R&D budgets, as shown in Figure 6, while adopting commercial technologies faster.

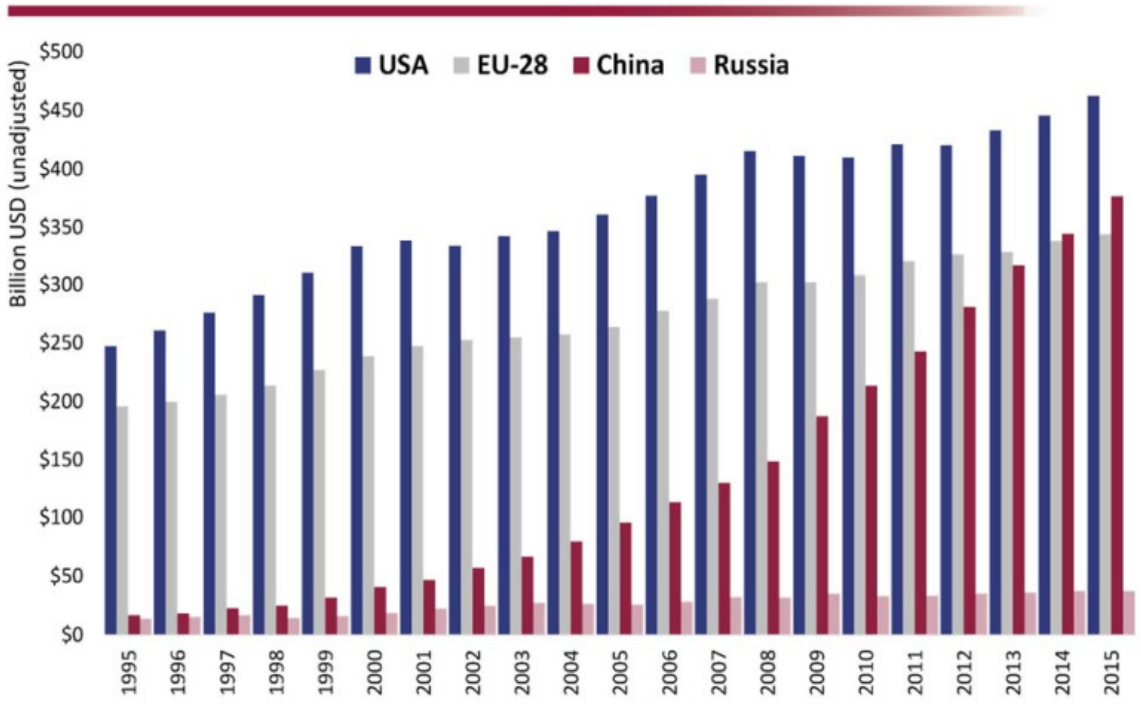

Figure 6. Military Research Budgets (Section 809 Panel, 2017)

Volume 2 of the Section 809 reports contains a section titled "Today's Strategic Environment Demands Greater Speed and Innovation" where the panel also observes the 2018 *National Defense Strategy* wanting to focus the DoD on long term strategic and technological competition which is in conflict with the changing markets and technologies. The report notes that legacy programs and systems are not responsive or agile enough with current acquisition practices and that other avenues must be explored to be effective. The volume continues to point out that roadblocks to acquisition must be removed like excessive process, inconsistent funding, poor or overly defining/restricting requirements, and long decision timelines, and suggests more use of other transaction authorities and a different model like:

> The United States Special Operations Command's (SOCOM) acquisition model comprising speed, risk tolerance, scale, inclusivity, and relationships. The acquisition culture in this model "emphasizes an aggressive, operator-focused and innovative acquisition culture with an emphasis on agility and speed of delivery to the customer. (Section 809 Panel, 2018b, pp. 4–5)

Part of SOCOM's rapid business model is reducing decision making entities and bureaucracy with smaller team sizes with the intent to achieve a partial but useful, rapid, and effective capability, with follow on efforts to fully mature the capability after it has had some time to prove its abilities. This process enables the warfighter to have a capability and be directly involved in the development of the system they are specifically using (Robinson, 2015). Another element of their success is using subject matter experts, providing continuous testing, and defining minimal acceptable criteria or requirements (Robinson, 2015). NSWC Dahlgren and Battle Management System was key in development of SOCOM capabilities (NSWC Dahlgren Corporate Communications, 2020).

3. Government Accountability Office Reports and Recommendations

The GAO is often tasked by Congress to conduct studies of the DoD in various degrees to provide an independent assessment of programs, processes, effectiveness, and cost-benefit analyses (Government Accountability Office, 2012, 2015, 2021). These studies typically produce both suggestions for improvement and a look into the inner workings of the DODs programs or larger polices for decision makers (Government Accountability Office, 2012, 2015, 2021). The GAO solicits feedback from programs and other leaders on their assessment and their recommendations forming a constant feedback loop that provides an effective means to understand causes, fixes, and impacts which can often result in later congressional direction through an NDAA language (Government Accountability Office, 2012, 2018, 2021).

The DoD is known to be very slow to enact change, to only partially enact recommendations, or to ignore recommendations all together (Government Accountability Office, 2015). It is obvious when the GAO follows up on programs or policies that even implementation of a recommendation is often slow to actually be impactful as the change must flow down through multiple leadership levels, often require some generation of policy, and also change scope which often comes at a cost (Government Accountability Office, 2015). The GAO concluded in their GAO-16-18T report:

> Describing the current acquisition process as "broken" is an oversimplification, because it implies that I can merely be "fixed." The current process, along with its outcomes, has been held in place by a set of incentives – a culture – that has been resistance to reforms and fixes. (Government Accountability Office, 2015, p. 9)

Statements like "too often, GAO reports on the same kinds of problems today that it did over 20 years ago" (p. 2) report on actions needed jointly by the DoD and Congress for acquisition and execution reform also help to elaborate on the inertia of the bureaucracy through Congress and the DoD (Government Accountability Office, 2015). This report also identifies the same elements needed for new weapons programs in development: better and feasible requirements needed, technology needs to be matured, cost estimates and schedules needs to be realistic, and the acquisition strategy needs incremental and informed steps or milestones (Government Accountability Office, 2015).

The DoD labs like the Navy's Warfare Centers, or how these labs are used and operated, have been under scrutiny in some reports. In one report, the GAO is blunt in how the Navy's labs were being supported under a specific congressional authority for internally initiated research, meant to foster innovation, was being poorly utilized (Government Accountability Office, 2018). Two examples provided involved facility investments and research funds. Out of the Navy's total budget, no dollars were asked for to improve or expand Warfare Center capabilities for several years leading up to FY2018, and for the sixteen labs plus Marine Corp labs not listed, of which there were eight Surface Warfare Centers, $7.3 million in capital working funds were used for lab recapitalization and upkeep versus $32.9 and $53.7 million for Air Force and Army labs, respectively, for a similar number of labs (Government Accountability Office, 2018). It is also worth noting that the DoD's lab budget was $66 billion, of which the Navy received over 1/3 of the budget (Government Accountability Office, 2018). For internally funded research, the Navy also ranked dead last in funds available as they charged a 1% fee on funded efforts, versus the 3–4% fees of the other Service labs (Government Accountability Office, 2018), resulting in less funds for innovation or creative efforts. In the same surveys, the lab directors ranked infrastructure as one of the most important elements to increase efficiency while actual funded research was most likely to promote innovation (Government

Accountability Office, 2018). The GAO also noted that the Navy completely missed its hiring authority targets in 2017 by hiring only 19% of its target (Government Accountability Office, 2018). The report noted that when provided with the proper resourcing, the Warfare Centers were very effective, like NSWC Crane developing and fielding a anti-unmanned aerial system capability for an urgent need in seven weeks to warfighters in need (Government Accountability Office, 2018). Another report noted that Program Offices that utilized the DoD labs for a tailored commercial-off-the-shelf (COTS) solution or unique government designed solution versus a completely contractor and/or COTS option were much more likely to be successful, on time (or early), within budget, and delivered the desired capability (Government Accountability Office, 2012).

With funding being a critical element to program execution, the GAO assessed how the DoD was operating with CRs between 2010–2020 where all years except 2019 included a CR (Government Accountability Office, 2021). Their report, culminated from a series of surveys from the Services, found that the DoD largely mitigated the impact of the CR each year for their major acquisition programs, which makes sense considering that most programs in the DoD are large executions with multi-year funding, and operational and maintenance funds are given priority outside of the CR (Government Accountability Office, 2021). Innovation is typically not a large program or is a capability enhancement that is funded as part of a program (LaMorte, 2022); thus, the CRs would impact these efforts and the GAO also came to this conclusion since it is also outlined in several regulations and compliance documents that govern the DoD (Government Accountability Office, 2021). GAO surveys also showed this negative impact to new program or activity starts and further stated that the CR's delay was often exaggerated further than just the CR timeline into a new program, further adversely impacting total costs and timelines (Government Accountability Office, 2021). The DoD does also make limited requests during a CR to fund new programs, alter existing programs (like adding a capability), or to increase production rates for existing programs; during this report's period, the DoD requested 1,198 exceptions and had 40 approved, or 3% of their requests. (Government Accountability Office, 2021)

E. SUMMARY

Innovation, what it is, and how to execute an innovative program within the confines for both DoD and industry environments are explored, and core tenets to this section. The key measures for innovation and its execution within the DoD (creating the idea itself, acceptance of the idea, cost, schedule, risk, and usefulness) are established allowing for entities to be evaluated and thus compared to other entities as well. An additional measure from the Skunk Works organization is pulled directly from Kelly Johnson's 14 Rules to enable an additional evaluation to compete in the industrial or commercial environment as the DoD continually seeks to be competitive in this environment and often attempts to leverage commercial best practices as these have enabled industry to outpace government capabilities, innovation, and execution. The difference between these two sets of measures provides an additional insight into the impacts of government and DoD rules, regulations, and policies that may be limiting the DoD's ability to innovate and acquire innovations.

Entities from multiple levels of the DoD are explored, providing elements to compare against the above measures. The high-level DIU entity specifically established to focus on innovation is able to be compared against more typical joint and Service-centric program offices, followed by an engineering and developmental brain trust provided by the Navy's NSWC Dahlgren. To provide a more thorough assessment, these government entities will be compared to a combined and very capable commercial entity represented by both Starlink and Skunk Works, as they both execute efforts in the commercial and DoD acquisition environments effectively. The comparison of these entities highlights strengths and weaknesses, and provides insights into limitations or roadblocks coming from policy, the organization itself, or other attributes that are preventing innovation and its acquisition.

III. METHODOLOGY OF COMPARISON

A. APPROACH

Part of the NPS's Defense Program Management curriculum is to understand, practice, and perform cost benefit, cost effectiveness and other comparative analyses to allow for logical decision making. The curriculum, while having a course (MN3070 – Fundamentals of Cost Benefit Analysis) focused on cost benefit analysis, also incorporates these analysis into many other of its courses to provide continuous assessment of problems (Naval Postgraduate School, 2024) and in large part is driven by the Academic Associate Dr. Robert Mortlock, COL (Ret.) who also helped to author the earlier background article on "Closing the Innovation Gap by Rethinking Defense Acquisition Education." These analyses would typically focus on triple constraints of cost, schedule and performance with the assumption that scope or requirements would be assumed consistent to meet the minimum viable product. Courses of actions (COA) or options to issues are developed and compared. Measures, like cost, could be made more significant or impactful by weighting the measure to coincide with stakeholder or external factors like budget constraints in this comparison. Each measure will receive a value based on the COA's impact to that specific measure on a predefined scale, ultimately allowing for a total score to allow COAs to be logically compared (Mortlock, 2020).

B. MEASURES FOR COMPARISON

For this analysis, a similar approach is used considering the interdependent nature of the innovation points in this paper, organizations involved, the DoD's and organizations' use of the DAS, and the ultimate customer, warfighters, needing innovation in the development and fielding of capabilities. Five types of organizations are compared: the NSWC Dahlgren, the DIU, a joint effort in a theoretical Program Office following DoD 5000, a Service-oriented effort in a similar Program Office, and an innovative commercial entity like Skunk Works or Starlink.

The evaluation will be broken into two comparisons with each measure being assessed on a scale of 0 to 3; a higher summation equates to a better innovation capability

or alignment. The first comparison assesses innovation and the key points presented earlier with more specific measures relating to the background information. Shown in Table 5, each of the five entities is assessed on the each of the key points, with multiple measures per key point, versus a potential score. Note that each of the key points has a label that corresponds to the scoring criteria; for example, an innovation key point can be measured between 0 and 3 based on No Ability/Awareness to High/Expert Ability.

Table 5. Innovation Ability Score: Key Points and Scoring Criteria

Innovative Ability Score for DoD

Key Point	Key Point Measure	Key Point	Key Point Measure
Innovation-1	Gap/Need Awareness	Schedule-1	Ability to Execute
Innovation-2	Internal Idea Creation	Schedule-2	Time to Fill Gap/Need
Innovation-3	External/Contractor Idea Creation	Risk-1	Idea Prototyping
Idea Acceptance-1	Leadership Complexity	Risk-2	Idea Transition
Idea Acceptance-2	Idea Approval	Risk-3	Testing
Idea Acceptance-3	Requirements Generation and Completeness	Risk-4	Ability to Mitigate
Cost-1	Funding Available	Usefullness-1	Ability to Transition
Cost-2	Contracts Execution	Usefullness-2	Ability to Mass Produce

Scoring for Innovative Ability Score for DoD

Score	Innovation	Usefulness	Idea Acceptance
0 – Bad	No Ability/Awareness	No Ability	No Influence/Very Complex
1 – Eh	Minimal Ability/Awareness	Minimal Ability	Minimal Influence/ Complex
2 – Good	Some Ability/Awareness	Some Ability	Some Influence/Minimal Complexity
3 – GREAT!	High/Expert Ability	High Ability	Very Influential/No Complexity
Score	**Schedule**	**Risk**	**Cost**
0 – Bad	No Ability/Very Long Time – Miss Gap	High Risk	No Influence/Capability
1 – Eh	Minimal Ability/Long Time/Late to Gap	Medium Risk	Minimal Influence/ Capability
2 – Good	Some Ability/Reasonable Time	Low Risk	Some Influence/ Capability
3 – GREAT!	High Ability/Very Short Time	No Risk	High Influence/Capability

The second comparison analyzes the opinion of how well the five types of organizations apply Kelly Johnson's fourteen rules from the background information presented earlier. Like the previous comparison, Table 6 shows Kelly Johnson's fourteen rules, a description of each rule, and then a 0 to 3 scoring criteria.

Table 6. Kelly Johnson's Rule Criteria and Alignment Score. Adapted from Johnson (2018).

Kelly Johnson's 14 Rule Comparison Analysis

Rule	Rule Description	Rule	Rule Description
Rule 1	Manager Has Complete Control Over Program and Reports Directly to Organization Leadership	Rule 8	Defined, Testable Requirements
Rule 2	Small, Strong Combined Contractor/ Government Project Office	Rule 8	Approved Inspection and Test Plan
Rule 3	Small, Capable Project Team	Rule 9	Iterative Testing and Demonstrations
Rule 4	Simple Configuration Management with Agile Update Capability	Rule 10	Defined, Testable Specifications (Requirements)
Rule 5	Minimal and Strategic Reporting	Rule 11	Timely and Appropriate Funding
Rule 6	Routine Cost Review and Continuous Total Cost Tracking	Rule 12	Government/Contractor Trust and Strong Working Relationship
Rule 7	Contractor or Project Team Assumed Risk Responsibility and Can Properly Own Risk	Rule 13	Security Awareness, Facilities, and Requirements
Rule 7	Commercial or Government Contracting Practices	Rule 14	Individual Performance Incentives

Scoring
0 – Unlikely to Meet
1 – May Marginally Meet
2 – Likely to Partially Meet
3 – Meets or Exceeds

C. ASSUMPTIONS AND LIMITATIONS

The analysis presented is derived from the background information, and the information cannot be expected to be true or all-inclusive for every situation as there are always exceptions and special circumstances that can affect the ability to execute an effort. The policies, regulations, and analysis of the many programs presented do however create

a baseline and general expectation of performance. Insight into government programs, program offices, and the DoD are limited in the public domain, but policies, rules, and regulations along with budgets provide direction into execution, approaches, and operating principles. Warfare center perspectives have been focused on their own internal and self-funded capability for innovation consideration, whereas most of their efforts are funded through program offices or the Services which come with a pre-defined problem set. Likewise, program offices are tasked to fill a gap from the Services or warfighter needs, and commercial entities are trying to fill a gap or expand market share with an affordable, capable, and ideally unique product or support structure. A Service effort is limited to a single military Service and with the blessing or support of their chain of command, where as a Joint effort implies multiple Services with multiple chains of command focused on their particular needs or uses.

IV. FINDINGS

A. INNOVATION ABILITY SCORE FOR DOD

A raw data table with the reasoning, obtained from the above research and references, and a score for each measure and organization from the scoring criteria for the Innovation Ability Score per Table 5 is found in Figure 7 and again in a larger, easier to read table in the Appendix in Table 9. The summary of the results is in Table 8.

Innovative Ability Score for DOD											
		Naval Surface Warfare Center Dahlgren		DOD Innovative Group (DIU, DIB, etc.)		Department of Defense Joint Effort		Department of Defense Service Specific Program Office Using Rapid Acquisition Practices		Innovative Commercial Entity	
Key Point	Measure	Reasoning	Score	Reasoning	Score	Reasoning	Score	Reasoning	Score	Reasoning	Score
Innovation-1	Gap/Need Awareness	Tied into Program Offices, Service Needs, and Threat Assessments	3	Tied into Program Offices, Service Needs, and Threat Assessments	3	Tied into Program Offices, Service Needs, and Threat Assessments	3	Tied into Program Offices, Service Needs, and Threat Assessments	3	Some gap awareness, but high market awareness	2
Innovation-2	Internal Idea Creation	Engineering Experts and Subject Matter Experts	3	Some with subject matter experts on staff or accessible; relies on contractors	2	Very little; depends on warfighter and external entities	1	Very little; depends on warfighter and external entities	1	High, creator of solutions and subjet matter experts	3
Innovation-3	External/ Contractor Idea Creation	Some awareness and teaming, but not typically part of conferences, request for proposals, and does minimal industry requests	2	Excellent; tightly tied to industry and commercial partners	3	Excellent; tightly tied to industry, commercial, and government partners	3	Excellent; tightly tied to industry, commercial, and government partners	3	High, and can create partnerships quickly/more easily than the Government	3
Idea Acceptance-1	Leadership Complexity	Multiple levels of leadership to reach internal innovation funds	1	Minimal as Group is the approver and executer	3	Very complex when with multiple service decision makers	0	Low complexity, but stil requires several approvals	2	Low to none; can freely execute at will	3
Idea Acceptance-2	Idea Approval	Very few ideas approved due to low budget and complex leadership	1	Very influencial/approves ideas	3	Approval authority, but must also approved by several services and joint boards	0	Approval authority with service blesssing	3	Direct approver	3
Idea Acceptance-3	Requirements Generation and Completeness	Subject Matter Experts, but very unlikely to capture everything needed for transition, especially with a very limited budget	2	Some capability and relies on contractors, but unlikely to be complete for transition	2	Highly complex process with likelihood for requirements to change over time with multiple service decisions	1	Great generation with service, warfighter, and idea developer to meet service need	3	Subject matter experts for idea and product, but likely to lack DOD requirements	1
Cost-1	Funding Available	Very little for internal efforts	1	Blessing of Secretary of Defense and influence their own budget	3	Typically good, but multiple service priorities and continuing resolutions are impactful	2	Great with service priority, but can be impacted by continuing resolutions	2	Complete control of internal funding	3
Cost-2	Contracts Execution	Internal contracting office, but can be limited in scope	2	Effectively executes and manages contracts	3	High capability typically with internal contracting office	3	High capability typically with internal contracting office	3	High capability with internal contracting office	3
Schedule-1	Ability to Execute	Small budget limits resources and time to execute	1	Can turn on a project nearly at will and uses latest flexible acquisition authorities	3	Can be very slow to start with multiple joint approvals needed, and complicated with joint requirements and changes	1	Good ability, but dependent on funding availability in fiscal year	2	Complete control of schedule execution	3
Schedule-2	Time to Fill Gap/Need	Likely to be a year for internal funds alignment/allocation before idea will start execution	1	Likely to fill gap quickly with quick turn-on and development	3	Can be very slow to start with multiple joint approvals needed	1	Good ability, and if really needed, service will move monies to execute	3	Can leverage resources, contracts, etc. at will to fill need	3
Risk-1	Idea Prototyping	Possible if funding allows	2	Utilizes contracts and contractors to develop and execute quickly	3	Utilizes contracts, funds transfers, and contractors to develop and execute quickly	3	Utilizes contracts, funds transfers, and contractors to develop and execute quickly	3	Complete control to execute	3
Risk-2	Idea Transition	Some ability if funding and timeline allow for effective prototype build and testing	2	Can support some transition to warfighter directly, and work with Program Offices for longer term transition	2	Transition authority with joint approvals needed, which can cause complications	2	Transition authority	3	Requires government approval and partnership made by demonstrations or lobbying	1
Risk-3	Testing	Some ability and typically local facilities, but funding and schedule limit ability to actually test	1	Directly funds and executes testing with Contractor	3	Directly funds and executes testing with contractor and government entities, but joint requirements may complicate or greatly expand testing and timelines	2	Directly funds and executes testing with contractor and government entities for service needs	3	Can test most capabilities, but will require government help to fully test systems for warfighter	2
Risk-4	Ability to Mitigate	Minimal to no capability with limited budget and resources	0	High ability with contractor and risk mitigation planning	3	High ability with contractor and/or governmental entities and risk mitigation planning, but may be complicated with unique service needs or requests	2	High ability with contractor and/or governmental entities and risk mitigation planning	3	High capability to mitigate	3
Usefullness-1	Ability to Transition	Minimal and idea likely to need rework to meet true needs due to limited budgets and resources	1	Can support some transition to warfighter directly, and work with Program Offices for longer term transition	2	Transition authority	3	Transition authority	3	Requires government approval and partnership made by demonstrations or lobbying	1
Usefullness-2	Ability to Mass Produce	None without external funding or assistance	0	Some with commercial partnerships and transitions to program offices	2	High capability with execution plan and contracts	3	High capability with execution plan and contracts	3	Complete control to execute	3
		TOTAL	23		43		30		43		40

Figure 7. Innovative Ability Raw Scoring Data

Table 7. Innovative Ability Scoring Summary

Innovative Ability Score for DoD

	Naval Surface Warfare Center Dahlgren	DoD Innovative Group (DIU)	Department of Defense Joint Effort	Department of Defense Service Specific Program Office Using Rapid Acquisition Practices	Innovative Commercial Entity
Key Point	**Score**	**Score**	**Score**	**Score**	**Score**
Innovation-1	3	3	3	3	2
Innovation-2	3	2	1	1	3
Innovation-3	2	3	3	3	3
Idea Acceptance-1	1	3	0	2	3
Idea Acceptance-2	1	3	0	3	3
Idea Acceptance-3	2	2	1	3	1
Cost-1	1	3	2	2	3
Cost-2	2	3	3	3	3
Schedule-1	1	3	1	2	3
Schedule-2	1	3	1	3	3
Risk-1	2	3	3	3	3
Risk-2	2	2	2	3	1
Risk-3	1	3	2	3	2
Risk-4	0	3	2	3	3
Usefullness-1	1	2	3	3	1
Usefullness-2	0	2	3	3	3
TOTAL	**23**	**43**	**30**	**43**	**40**

The scoring shows that specifically setup DoD entities with the authorities, funding controls, and knowledge bases close to an acquisition office are very capable of being innovative. The ability of these organizations, like the DIU, shows that the DoD can promote and support innovation effectively, ultimately benefiting the warfighter the most. This comes from tight controls over its program elements like funding, contracting, and acquisitions practices with direct interfacing to contractors or development entities which

provides the ability to quickly turn on development, interface with warfighters, and ultimately execute innovation.

Tying for first is a program office executing a single Service initiative with the newest adaptive acquisition framework practices and authorities; and an innovative commercial entity like Starlink. The program office, which has established acquisition practices, leadership, oversight abilities, and industry networking is able to concentrate on the particular Service need and direction to execute the development as well as set the effort up for direct transition to the warfighter; common budgetary issues like CRs are the largest deterrent that can have the most effect on schedule when the particular Service has blessed the effort.

A commercial entity is much more efficient in execution practices and can make decisions more rapidly, as well as turn on an effort at will. While the commercial entity can quickly create and execute, to be useful to the warfighter, the product must be transitioned and usable to the warfighter, which the commercial entity by itself is unlikely to fully encompass in their development and testing; and must market their creation to the DoD for it to be picked up for transition. The defense and governmental sectors are also not the most influential sectors, and thus the innovation may be geared toward more profitable and wider reaching commercial sectors; or if specific to government and defense sectors, likely incomplete due to a lack of requirements from the government.

Less likely to effectively execute an innovative idea is a Joint Program Office or Program Office working a Joint initiative. While this is considered to have the same capability or even be the same Program Office as the Service centric effort, the "joint" paradigm adds in multiple decision makers; additional processes, requirements, and reports; and a more complex budget structure that effectively slow down and complicate the ability to innovate. Being "joint" also provides a high probability to follow more traditional, longer acquisition practices.

The least likely to execute an innovation is the NSWC Dahlgren. While the center and its fellow centers contain the engineering and technical knowledge bases for the Navy, minimal funding is set aside for internal innovations which is a major deterrent. A lack of

investment in facilities or control over the facilities, confused thrusts or internal direction, and budget impacts like CRs reduce the probability that an effort will execute, and further make successful transition less likely.

B. KELLY JOHNSON'S 14 RULE COMPARISON

With the changing scope of today's adversaries being more innovative, utilizing advanced commercial technologies to enhance their gaps, and reducing roadblocks to fielding solutions to their warfighter capability gaps that are cost effective and challenging DoD capabilities (Ankel, 2023; Govini, 2021), the DoD is eager to become more innovative. The comparison to Kelly Johnson's Fourteen Rules for an effective, innovative organization have proven to provide quick, effective, and useful innovations for the warfighter as seen by the many successes of the Skunk Work's organization (Lockheed Martin, 2024b, 2024c; J. Miller, 1995). Johnson's rules assume that transition pathways are defined and agreed to with a Service (J. Miller, 1995). Therefore, an organization that can follow and utilize Johnson's Fourteen Rules should also be successful.

A raw data table with the reasoning, obtained from the above research and references, and a score for each measure and organization from the scoring criteria for the Fourteen Rules Comparison is found in Figure 8 and then in an easier to read format in the Appendix in Table 10. A summary of the results is in Table 8.

14 Rule Comparison Analysis											
		Naval Surface Warfare Center Dahlgren		DOD Innovative Group (DIU, DIB, etc.)		Department of Defense Joint Effort		Department of Defense Service Specific Program Office Using Rapid Acquisition Practices		Innovative Commercial Entity	
Rule	Rule Description	Reasoning	Score	Reasoning	Score	Reasoning	Score	Reasoning	Score	Reasoning	Score
1	Manager Has Complete Control Over Program and Reports Directly to Organization Leadership	Matrix organization, multiple layers of management	1	Manager must utilize Government Contracting Rules and Regulations, but Group works directly with Contractor	2	Manager must utilize Government Contracting Rules and Regulations; Joint implies many stakeholders and layers of management	0	Manager must utilize Government Contracting Rules and Regulations, but Office works directly with Contractor	2	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
2	Small, Strong Combined Contractor/Government Project Office	Minimal internal team due to lack of funding; separate project offices	1	Group works directly with contractor	2	Unlikely to be a small or strong office with multiple services	0	Office works directly with contractor and is very knowledgeable in execution practices	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
3	Small, Capable Project Team	Little or minimal innovation funding likely to produce knowledge gaps	1	Contractor determines team within approved budget	3	Contractor and/or multi-service development team unlikely to be small or co-located	0	Contractor determines team within approved budget	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
4	Simple Configuration Management with Agile Update Capability	Little funding, matrix organization, partial agile process implementation	1	Contractor likely determines Configuration Management and Group must have knowledge base to properly define too. Good contracting practice will protect Government Data rights.	3	GAO reports typically show a lack of configuration management, and each service likely to have their own processes/systems	0	Contractor likely determines Configuration Management with knowledgeable Office. Good contracting practice will protect Government Data rights.	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
5	Minimal and Strategic Reporting	Continuous reporting requirements for funding, multiple levels of organization	0	Contractor and Group report directly to each other	3	Each service will require reports	0	Contractor and Office report directly to each other; Office reports to Service	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
6	Routine Cost Review and Continuous Total Cost Tracking	Navy cost tracking, known to lag; minimal management funding	1	Contract defined reporting for Contractor	2	Each service likely to require different measure and use different accounting systems	0	Contract defined reporting for Contractor and Office maintains Government requirements with continuous assessment	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
7a	Contractor or Project Team Assumed Risk Responsibility and Can Properly Own Risk	Team will own all risk but unlikely to have budget or schedule to properly mitigate or track	0	Contract defined and properly funded	3	Team will assume risk, but risks likely to be different for each service needs and requirements	1	Contract defined, properly funded, and risk management process and plan established for both Contractor and Government	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
7b	Commercial or Government Contracting Practices	Government practices, which have to flow through Dahlgren and NAVSEA	1	Government Practices using latest DOD 5000 authorities which can expedite efforts	2	Government practices, and likely through multiple services	1	Government Practices using latest DOD 5000 authorities which can expedite efforts and likely with contracting officer or authorities	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
8a	Defined, Testable Requirements	Minimal funding prevents appropriate investment in requirements development	0	Contractor defined, but may change to transition	2	Contractor will define requirements, and services will likely change their requirements as program develops	0	Contractor defined and Government/Office approved to ensure warfighter needs met	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
8b	Approved Inspection and Test Plan	Funding and associated management restrictions unlikely to produce test plans; testing at government facilities is expensive	0	Contractor defined and Group must have proper knowledge base to agree to	2	Each service likely to require different testing and change testing requirements or demonstration during development	0	Contractor defined and Office approved to meet warfighter needs	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
9	Iterative Testing and Demonstrations	Minimal funding will limit testing, prototyping, and demonstrations	0	Contractor defined, but likely to be expanded for transition which will increase budget, schedule, and scope	2	Contractor defined, but services likely to change testing and demonstration requirements	0	Contractor defined and Office approved to meet warfighter needs	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
10	Defined, Testable Specifications (Requirements)	Minimal funding prevents appropriate investment in requirements development	0	Contractor defined, but may change to transition	2	Contractor will define requirements, and services will likely change their requirements as program develops	0	Contractor defined and Office approved to meet warfighter needs	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
11	Timely and Appropriate Funding	Continuing Resolutions and minimal innovation funding	0	Continuing Resolutions likely to have impacts, but can be partially mitigated with planning; schedule impact	2	Likely to have adequate funding, but highly likely to be impacted by Continuing Resolutions and Service needs; schedule impacts	2	Continuing Resolutions likely to have impacts, but can be partially mitigated with planning; schedule impact	2	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
12	Government/Contractor Trust and Strong Working Relationship	Minimal funding and contracting rules/regulations heavily structure relationship	1	Group and Contractor direct communications with Government Contracting Rules	2	Multiple government stakeholders unlikely to maintain a strong relationship	0	Office and Contractor direct communications with Government Contracting Rules	2	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
13	Security Awareness, Facilities, and Requirements	Minimal to no infrastructure investment; must use existing infrastructure	1	Contractor defined, but Group/Transition partner may impose additional security requirements	2	Facilities likely to be adequate, by requirements very likely to change or be unique to each service	0	Contractor and Office approved as part of initial requirements	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
14	Individual Performance Incentives	None or little typically based on number of personnel or budget managed; government pay restrictions and tight funding	0	Largely a group of commercial or prior military service contractors, executing contracts and thus able to be rewarded	3	Little to none for group; potential for contractors to be provided incentives from company	1	Little to none for group; potential for contractors to be provided incentives from company	1	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
		TOTAL	8		37		5		43		48

Figure 8. Kelly Johnson's Fourteen Rules Raw Scoring Data

Table 8. Kelly Johnson's Fourteen Rules Scoring Summary

Kelly Johnson's 14 Rule Comparison Analysis

Rule	Naval Surface Warfare Center Dahlgren	DoD Innovative Group (DIU)	Department of Defense Joint Effort	Department of Defense Service Specific Program Office Using Rapid Acquisition Practices	Innovative Commercial Entity
	Score	Score	Score	Score	Score
Rule 1	1	2	0	2	3
Rule 2	1	2	0	3	3
Rule 3	1	3	0	3	3
Rule 4	1	3	0	3	3
Rule 5	0	3	0	3	3
Rule 6	1	2	0	3	3
Rule 7a	0	3	1	3	3
Rule 7b	1	2	1	3	3
Rule 8a	0	2	0	3	3
Rule 8b	0	2	0	3	3
Rule 9	0	2	0	3	3
Rule 10	0	2	0	3	3
Rule 11	0	2	2	2	3
Rule 12	1	2	0	2	3
Rule 13	1	2	0	3	3
Rule 14	0	3	1	1	3
TOTAL	**8**	**37**	**5**	**43**	**48**

As expected, the innovative commercial entities like Skunk Works or Starlink who practice and operate by the rules have a high innovation ranking.

A program office utilizes authorities and practices from the Adaptive Acquisition Framework for and with a specific Service blessing and supporting the effort are able to effectively execute innovative efforts. The largest deterrents are DoD budget uncertainty and delay, especially with a new effort and impacts of a CR, and then a lack of governmental incentives especially if using a government lab, which can be mitigated with

utilizing contractor efforts and incentive contract clauses. A program office can largely make its own decisions within the approved acquisition program baseline, though possibly with some additional Service oversight, which can slow the innovative process.

The next most effective organization is a DoD Innovative Group like DIU which is able to quickly execute an effort, but has the same drawbacks as a program office. The group is unlikely to have a long-term transition capability, relying on a Program Office and Service, which will add a degree of risk and additional step to effectively use the innovation and may add additional requirements later for the transition even with the expertise of the group.

The NSWC Dahlgren, with a very low score, shows a very small capability to be innovative. Much like that Innovative Ability Score, Dahlgren is highly hindered by very low internal development budgets to share between technical and engineering experts, which results in poor transition setup to be widely effective to fill a gap. The warfare center must also solicit to a program office without the typical plan and infrastructure behind its idea versus a commercial entity.

With multiple levels of bureaucracy, management, stakeholders, and budgets; a Joint Program Office is unlikely to be effectively innovative per Johnson's rules.

C. SUMMARY

The Innovation Ability Score for DoD and the Kelly Johnson's Fourteen Rule Comparison above both show how multiple small questions or measures can asked, scored, and culminated to provide an effective overall comparison of several organizations or other courses of action vs. each other.

The Innovation Ability Score for DoD reveals that DoD centric entities are well aligned to warfighter and mission needs than commercial entities, with most reasoning for this being integrated into the DoD structures and information availability verse commercial entities. The Kelly Johnson's Fourteen Rules analysis suggests close alignment also, with commercial entities gaining an edge largely due to budget, approval, and specialized requirements adding delays for government entities.

Both analyses reveal that the Warfare Centers rank well below successful and innovation focused governmental and commercial entities; and that the Centers are about as effective as a Joint Program Office effort in terms of being innovative or able to execute a new idea. Many reasons including a lack of authorities, complex organizational structures, a lack of autonomy, minimal funding, and a lack of investment prevent the Warfare Centers from being more innovative.

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V. CONCLUSIONS AND RECOMMENDATIONS

A. RESEARCH QUESTIONS SUMMARY

(1) How can Naval Surface Warfare Centers be optimized to provide more innovative thinking and new product creation?

With the limitation that only one Warfare Center was studied and only from publicly available sources of information, it is possible that other Warfare Centers are slightly different or more capable at being innovative. However, this research found fundamental issues that prevent innovation at the Warfare Centers of the Navy. Personnel at Dahlgren, being mostly engineers (Naval Sea Systems Command, 2022) are likely a creative and innovative population. The research showed that to make an idea into reality, additional effort is needed to convince leadership, obtain funding, gain help or resources, build and test with prototypes, and ultimately transition to produce the capability (Blank, 2006). One would reasonably expect that an organization and center setup to problem solve with a vision to provide "innovative cost effective technical solutions" (Naval Sea Systems Command, 2024c) and "design, develop, and integrate cutting edge…solutions" (Naval Sea Systems Command, 2021) would exemplify innovation, and there are some select examples. Battle Management System, which is part of NSWC Dahlgren, has multiple teams and members who have won awards for interacting with customers/warfighters, delivering capabilities much faster than expectations, seeking out new technologies to integrate or create new products with, and truly innovating with customers to understand the realm of possible while creating new capabilities (DVIDS, 2021, 2022). This organization is completely funded through Program Offices and the Services and both consistently impresses and lands sponsors with new ideas, working concepts, and usable capabilities (DVIDS, 2021, 2022). Further, empowering capable project team leads who work directly work with sponsors to not only understand needs but to offer suggestions and improvements offers "a good workspace to try out a lot of things" that ultimately benefit the end user, stakeholders, and DoD at large (DVIDS, 2022). Dahlgren's world-renowned and Joint Service chemical and biological department which even provided a namesake for their Dahlgren Decon agent, also showed that innovation is possible, albeit with external

funding sources, close external sponsor relationships with supporting sponsors (Dyson, 2018; NSWC Dahlgren Public Affairs, 2002) before being relocated, or arguably disbanded per employee perspectives, to another base with no supporting facilities (Dyson, 2018), showing a lack of support from NSWC Dahlgren and potentially the Navy.

Government labor and overhead rates are more expensive than commercial or industry entities, putting the warfare centers at a disadvantage, and funding for innovation is small (S. Miller, 2022). The warfare centers and Navy do allocate a smaller portion of funding than other services and similar labs via allocation and internal fees (Government Accountability Office, 2018) resulting in less funding for pursuing innovative ideas. Questions about what the centers can and cannot do with this small pot of reserve funding, or ways to source and increase the overall pot of funding, is adding to the monetary roadblock (Naval Sea Systems Command, 2023a). Funding at Warfare Centers is therefore a major roadblock. The DoD has funding for innovation, as seen by the existence of DIU, DIB, and other entities existing with their budgets in the hundreds of millions of dollars in the NDAAs, but the Navy does not appear to be investing in the Warfare Centers or requesting investment, per the NDAAs.

The lack of an alignment of strategic direction is troubling and presents a difficulty to align efforts (*NISE PI Resources*, 2023) across warfare centers and for employees. NAVSEA's strategic thrusts for NSWC Dahlgren and its Dam Neck Annex do not appear to align or are not encapsulated in Dahlgren's own; as an example, NAVSEA's thrust for Dahlgren to lead electric weapons development and mission engineering (Naval Sea Systems Command, 2023b) are not found in Dahlgren's thrusts ((Naval Sea Systems Command, 2021, 2024a). Dahlgren's own strategic thrusts have also substantially reduced per Table 4 with little alignment to its Dam Neck Annex. Further, the observations by both the GAO and DIB emphasizes that defense culture being resistant to changes and heavily influenced by external forces heavily hinders leaders from taking risks or approving something new (Defense Innovation Board, 2024a; Government Accountability Office, 2015). NSWC's vision and mission statements, shown in Table 3, also show discontinuity and confusion. These misalignments allude to a larger lack of leadership and foresight likely impacting investments by Congress and the Navy.

The lack of facility ownership and control, demonstrated by the separation of NSWC Dahlgren being a tenant on NSF Dahlgren (Naval District Washington, 2024d), which effects the cost of testing, impacts the ability to add or change buildings/spaces, and adds in additional management layers, is contrary to innovative culture. The difference of mission and visions between the facility holders, NSF Dahlgren and the larger NSA South Potomac, to maintain and sustain facilities (Naval District Washington, 2024c) is contrary to the many NSWC Dahlgren mission and vision statements which generally push to develop, build, and deliver new solutions (Naval Sea Systems Command, 2021, 2024c)

The culmination of the above presents one very apparent observation: there's very little that the Warfare Centers themselves can do, outside of better aligning their thrusts and supporting successful organizations within their command, to be more innovative. That capacity to change at Dahlgren has been taken away over the years via establishing multiple separate commands and removing control over facilities; realignments and re-organizations; and investment and funding not being asked for. The ability to change is generally at levels above the center's local leadership.

(2) Are government rules and policies are altering the "innovative marketplace" in favor of commercial or industry verse government labs?

Every entity, whether commercial or government, must follow laws and rules to conduct business. There are also many differences, as discussed in the background information, between government and commercial entities and many of these differences come from operating rules, laws, and regulations. Budgets and appropriations of funds present a very clear difference: government entities must plan, program, and budget over a year for funds through multiple layers of management before entities are allocated funds. The PPBE process looked at earlier is an annual process flowing into the President's budget, which is typically submitted in early February for the next fiscal year starting 1 October; or roughly eight months away (Defense Acquisition University, 2024d). Congressional allocation after this request is not instant, and with CRs extended this timeline, funding is even further away from the start of the fiscal year (Government Accountability Office, 2021). There's also the factor that budget requests are prioritized before being considered (Defense Acquisition University, 2024d) and the Navy verse the

other Services in particular, is more focused on large projects and sustainment (Government Accountability Office, 2018) The appropriate approval timeline and inconsistency impacts Service planning efforts and directly impacts the ability to be innovative as noted by both the GAO and Section 809 panel (Government Accountability Office, 2018; Section 809 Panel, 2018b). If an idea is not within the bounds of an existing program that can flex funds and has a fitting appropriation, the other paths with discretionary funds has to be found, but those paths are minimal and, as we have seen, very poorly funded (Government Accountability Office, 2021). CRs, which have become commonplace, further impede innovation as new starts or changes from the previous year's budget cannot be made or have an extremely low probably of being accepted (Government Accountability Office, 2021). In contract, a commercial company, while having a management and approval structure, can push and execute funds and use them as needed to expedite a product to market or for use. For commercial companies, accountability largely falls to managers directly (J. Miller, 1995) versus many levels of management, approvals, and oversight for governmental systems. The approval processes and number of approval layers, as defined in the DoD acquisition processes (Government Accountability Office, 2015; Office of the Under Secretary of Defense for Acquisition and Sustainment, 2022b, 2022a), reveal another bottleneck for government entities that is streamlined for commercial entities. With only limited insight into commercial companies' R&D budgets, it is observed that commercial entities are increasing their R&D market share, outpacing government funding (Section 809 Panel, 2017). Further, the research highlights that the government labs have a relatively small internal budget for innovations, focusing instead on more sustained development efforts and technology maturation.

The execution of an innovative process, like Kelly Johnson's fourteen Rules for Skunk Works, reveal a difference in development and acquisition practices that have afforded non-governmental entities the ability to innovate more quickly, which is further seen in the shift of the government having reduced influence and a reduced researched and development market share compared to commercial entities (Govini, 2021). This shift is also seen with the government adopting and adapting more COTS equipment or solutions as they generally provide cheaper, quicker, on schedule capability than government

solutions (Government Accountability Office, 2012). The latest iteration of DoD acquisition policies, DoDI 5000.01, introduced new, more flexible, and more agile processes and authorities in 2020; but these processes and authorities are extensive changes and still being understood by acquisition entities. While the DoD acquisition workforce is very familiar with the DAS, it is noted that innovative practices are not well taught to the workforce with only an attempt being made to move senior leadership to more innovative thinking (Defense Acquisition University, 2024c, 2024g). Better acquisition education with a focus toward agility and innovation is starting to be practiced (Mortlock & Jones, 2023) but changes to the DoD culture will take time and need to spread through levels of leadership (Government Accountability Office, 2015). When attempting to be innovative, government entities, especially for the DoD, typically have an increased number of requirements to better prepare the idea for transition and future deployment thanks in large part to the requirements imposed by acquisition practices (Schultz, 2023) which makes for an easier adoption by leadership. Companies, on the other hand, can take on risk to create a product, sell it to the government, and then have the government pay for additional development for their unique requirements; this is displayed again and again with the attempt for government efforts to use COTS products (Government Accountability Office, 2012).

It becomes clear that government rules, policies, and the size of the bureaucracy alter the "innovation marketplace" in favor of commercial or industrial entities. While attempts are being made to streamline and gain efficiencies back for government labs and other entities, the rate of change is slow and the organizations are too complex to compete against the much more agile commercial sector. The DoD culture is also adding roadblocks with long instilled acquisition practices, slow-to-change responses, and many questions over new policies. The DoD is also buying commercial solutions and paying to update these systems, sometimes at extensive cost and schedule, versus breaking down barriers to support and encourage its highly capable workforce like those at NSWC Dahlgren.

(3) Are Warfare Centers operating more as a government entity or as a regulated commercial entity?

The answers to the previous two questions show that the Warfare Centers have minimal authority to operate themselves or to determine their own destiny. They do not own and manage their facilities, and are forced to operate under multiple layers of controls, decision makers, policies, rules, and regulations. The layers of oversight for Dahlgren, whether from NAS South Potomac, NAVSEA, the Navy, the DoD, or higher levels of authority go beyond a regulatory commission for an entity like a power plant, which is also allowed to turn a profit and invest in itself (U.S. Department of Energy, 2020). Misaligned processes highlight that Warfare Centers are operating as a regulated government entity versus a commercial entity as it is internally constrained by DoD and other governmental rules and regulations. Long budget processes, a lack of investment, and minimal funds for internal research or idea exploration from the Navy's high concentration of engineering minds at the Warfare Centers and help to effectively shift the innovative balance in favor of commercial or industrial entities even though they may be more removed from the problem, gap, and customers/warfighters. It became obvious in this research that Warfare Centers operate as heavily controlled government entities; arguably more controlled or at least at a higher disadvantage than Program Offices and other acquisition entities, and other Services' research and development groups as services were at least asking for and obtaining investment in their own facilities per the NDAAs viewed. The DoD is also investing in other innovative entities like DIU and DIB who are literally buying or suggesting buying "innovation" from commercial partners verse internal DoD development labs (Defense Innovation Board, 2024a; Defense Innovation Unit, 2024a, 2024b).

With the combined suggestions from the DIU, DIB, GAO, and Section 809 panels from this research, all of which agree that commercial entities are more innovative, faster to solutions, and more agile due to many factors including budget, bureaucracy, processes, and culture, the Warfare Centers and its higher NAVSEA command should consider changing their operating structure while consolidating facility and command ownership. The culture, thus leadership, needs to be changed to effectively reset expectations and

roadblocks must be reduced and eliminated to become more effective. The Warfare Centers need a stronger voice amongst decision makers, budget discussions, and solution proposals with clear focus areas across the centers for the Navy and larger DoD needs. It is possible that government owned, contractor operated facilities would be far more effective and agile, creating a better innovative environment (Government Accountability Office, 2018) but only if the government and facilities can change and adapt to the needs of the research and development. Government-sponsored, contractor owned and run facilities may be far more effective yet (Government Accountability Office, 2018).

B. CONCLUSIONS

The research conducted sought to understand the innovative challenges to DoD and specifically to the Naval Surface Warfare Centers as the Navy continues to face more effective and capable adversaries, continues to utilize older technologies and platforms to perform its missions, and continues to develop new capabilities at a much slower pace than adversaries. The need for innovations, even if just integrating commercial products into military applications, could not be clearer than the real-world Ukraine example in our recent history (Schultz, 2023). Ukraine with limited naval capabilities quickly developed capabilities that are successfully combatting and defeating Russia's Navy at a fraction of the cost and with minimal cost of life (Schultz, 2023). Technologies exist that the Navy could integrate into warfighting systems to enhance capabilities but requires a culture of innovation, while the research has shown the DoD's own culture being resistant to change (Government Accountability Office, 2015) and a lack of support for its research centers (Government Accountability Office, 2018), with the Navy being the worst offender. While the DoD continues to restructure and provide more authorities to enable the military to gain and incorporate new capabilities, and has established specific innovation focused entities, the rate of change combined with the complexity and size of the DoD is limiting innovation within its organization.

C. RECOMMENDATIONS

The DoD was once known for innovations and inventions, leading to many of our society's current technologies. The Navy's labs were part of this innovative and creative

team, but need more autonomy, internal discretion of funding, and investments to be innovative.

(1) Provide direction from the DoD and Navy to allow the Warfare Centers to increase their tax on efforts for internal innovation and development funds; and work with Program Offices to provide an investment fund to offer the Warfare Centers some chances to fill warfighter gaps

The research and findings revealed that internal budgets, especially for the Navy's Warfare Centers, is a roadblock to innovation and further to enabling an innovation to be effective for transition and warfighter usage. Tying Program Offices closer to the Warfare Centers, especially with additional discretionary funding, will offer a more effective means to filling warfighter gaps while providing easier transition opportunities for useful innovations. Resolve questions surrounding internal research funds. Work with DIU, DIB, and other DoD innovation centric groups to gain awareness of Warfare Center capability, and to be considered for higher-level DoD investment.

(2) Promote a more inclusive sustainment role for Warfare Center groups with Program Offices

Dahlgren's Battle Management System group appears to have an expanded role with SOCOM beyond just research and development, including a sustain and support role providing continued innovation and support to SOCOM Program Offices. Being tied in with Program Offices, as an engineering and development team, provides the Program Office with subject matter experts who will linked to industry offerings and afford a more symbiotic relationship that ultimately benefits the warfighter. This continued feedback and support loop offered by sustainment or sustainment oversight will also provide better protection for programs and projects to protect the government, and thus warfighters, interests; inform developers about how warfighter needs are changing and what they are; and naturally solicit suggestions for improvements or whole new capabilities from technical brain trusts at the Warfare Centers.

(3) Reassess the separation of commands between Warfare Center facilities and Warfare Center operations

The separation of NSWC Dahlgren from ownership and operation of its own facilities presents a major deterrent to innovation and, with limited or no investment in many years per the NDAAs, is indicative of larger infrastructure problems and utilization of older technologies and networks for the Warfare Centers. The lack of any request by the Navy, again per the NDAAs, shows a divestment of the technological knowledge bases and technical authorities in an era when companies are continually building and expanding their research and development. The Navy's continued service life extensions and increase maintenance costs of the fleet, ballooning upgrade cost of pier and drydock facilities, and very long capability development cycles with multiple restarts (Govini, 2021) are indicative of larger problems and a decreasing capability to combat our adversaries in the future.

It is also suggested to explore government-owned, contractor operated facility agreements, at the least, to leverage the speed, agility, and cost effectiveness of commercial entities while tying them in tighter to warfighter needs. This suggestion prefaces support by the government of contractor requests to upgrade, improve, and maintain facilities as needed for the efforts being worked. This would also limit contractor facility risks from environmental and other regulatory rules. Explore the Department of Energy's agreements, as alluded to in the GAO-19-64 report. The Warfare Centers offer test facilities and ranges which have not been or would be extremely expensive to duplicate elsewhere, and are uniquely suited for military needs.

(4) Continue to invest and teach more innovative acquisition approaches, tailoring of approaches, and smart business decision practices

The revamping of the DoD's acquisition system more closely aligns to effective commercial practices, but application as well as what an authority can or cannot do hinders effective use of these new processes. A need exists for more effective acquisition practices, including tailoring processes and cost-benefit or similar analysis, was seen in the multiple GAO reports on program execution. NPS coursework with real-world examples as provided in the background information and resources introduces a smarter, logical

approach to business decisions and would inform investments, reducing risks and putting more rigor into program management and acquisition processes. Adjust current acquisition training to integrate real-world examples and analysis into training.

(5) Fund DIB to investigate Warfare Center and other labs practices toward innovation

The DIB has produced a number of findings to assist the DoD in moving into more effective acquisition and innovation practices, and carries influence to induce change as well as experience in what works and what does not. To enable the labs to become more effective, useful, and beneficial to the services and warfighters, a more in-depth review around the ability to innovate would produce constructive suggestions.

D. AREAS FOR FUTURE RESEARCH

Additional research is critical to inform and effect change to enable the DoD to again be more innovative, and to enable it to be more adaptive to new threats and challenges.

(1) Review other Navy and Service labs for innovation roadblocks

This research was limited to the NSWCs, with an emphasis on the largest Warfare Center, and the Navy operates several other flavors of labs like the Office of Naval Research and Naval Research Labs. This holds true for the other Services as well and if the same or similar roadblocks for innovation exist, could provide more credence and need to larger DoD recommendations.

(2) Increase the scope of evaluation for innovative commercial practices to further develop a measure for innovative ability, and standardize a set of metrics for assessment

The DoD is now in the habit of adopting commercial practices as they are proving to be more effective than current practices, but in multiple reports and analysis, often fails to follow up or continually assess progress of those adoptions. The lack of a feedback loop does not allow for continued improvement and tweaking of policies to enable more efficient execution and thus warfighter support. The DoD largely lacks an ability to

measure how innovative it is, instead opting to analyze technologies for their maturity, reliability, etc., to promote continued investment; and often is missing out on or slow to include better processes, technologies, and training that would benefit deployment, acquisition, and sustainment of products.

This research has attempted to provide measures in both the ability to transition an innovation for the warfighter and to assess the actual capability to innovate for very select organizations and idealized assumptions based on policy and program assessments. The measures presented should ideally be expanded to provide a more detailed look and assessment against the standard DoD acquisition practices and adaptive acquisition framework to understand how they apply to the different phases of acquisition; and this could likely inform how to decrease development time and risk if an organization is more aligned with innovative practices.

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APPENDIX. RAW DATA

Table 9. Innovative Ability Raw Scoring Data

Innovative Ability Score for DoD

		Naval Surface Warfare Center Dahlgren		**DoD Innovative Group (DIU, DIB, etc.)**		**Department of Defense Joint Effort**		**Department of Defense Service Specific Program Office Using Rapid Acquisition Practices**		**Innovative Commercial Entity**	
Key Point	Measure	Reasoning	Score	Reasoning	Score	Reasoning	Score	Reasoning	Score	Reasoning	Score
Innovation-1	Gap/Need Awareness	Tied into Program Offices, Service Needs, and Threat Assessments	3	Tied into Program Offices, Service Needs, and Threat Assessments	3	Tied into Program Offices, Service Needs, and Threat Assessments	3	Tied into Program Offices, Service Needs, and Threat Assessments	3	Some gap awareness, but high market awareness	2
Innovation-2	Internal Idea Creation	Engineering Experts and Subject Matter Experts	3	Some with subject matter experts on staff or accessible; relies on contractors	2	Very little; depends on warfighter and external entities	1	Very little; depends on warfighter and external entities	1	High, creator of solutions and subject matter experts	3
Innovation-3	External/ Contractor Idea Creation	Some awareness and teaming, but not typically part of conferences, request for proposals, and does minimal industry requests	2	Excellent; tightly tied to industry and commercial partners	3	Excellent; tightly tied to industry, commercial, and government partners	3	Excellent; tightly tied to industry, commercial, and government partners	3	High, and can create partnerships quickly/more easily than the Government	3
Idea Acceptance-1	Leadership Complexity	Multiple levels of leadership to reach internal innovation funds	1	Minimal as Group is the approver and executer	3	Very complex when with multiple service decision makers	0	Low complexity, but still requires several approvals	2	Low to none; can freely execute at will	3
Idea Acceptance-2	Idea Approval	Very few ideas approved due to low budget and complex leadership	1	Very influencial/approves ideas	3	Approval authority, but must also approved by several services and joint boards	0	Approval authority with service blessing	3	Direct approver	3
Idea Acceptance-3	Requirements Generation and Completeness	Subject Matter Experts, but very unlikely to capture everything needed for transition, especially with a very limited budget	2	Some capability and relies on contractors, but unlikely to be complete for transition	2	Highly complex process with likelihood for requirements to change over time with multiple service decisions	1	Great generation with service, warfighter, and idea developer to meet service need	3	Subject matter experts for idea and product, but likely to lack DoD requirements	1
Cost-1	Funding Available	Very little for internal efforts	1	Blessing of Secretary of Defense and influence their own budget	3	Typically good, but multiple service priorities and continuing resolutions are impactful	2	Great with service priority, but can be impacted by continuing resolutions	2	Complete control of internal funding	3
Cost-2	Contracts Execution	Internal contracting office, but can be limited in scope	2	Effectively executes and manages contracts	3	High capability typically with internal contracting office	3	High capability typically with internal contracting office	3	High capability with internal contracting office	3
Schedule-1	Ability to Execute	Small budget limits resources and time to execute	1	Can turn on a project nearly at will and uses latest flexible acquisition authorities	3	Can be very slow to start with multiple joint approvals needed, and complicated with joint requirements and changes	1	Good ability, but dependent on funding availability in fiscal year	2	Complete control of schedule execution	3
Schedule-2	Time to Fill Gap/Need	Likely to be a year for internal funds alignment/allocation before idea will start execution	1	Likely to fill gap quickly with quick turn-on and development	3	Can be very slow to start with multiple joint approvals needed	1	Good ability, and if really needed, service will move monies to execute	3	Can leverage resources, contracts, etc., at will to fill need	3

Innovative Ability Score for DoD

		Naval Surface Warfare Center Dahlgren		**DoD Innovative Group (DIU, DIB, etc.)**		**Department of Defense Joint Effort**		**Department of Defense Service Specific Program Office Using Rapid Acquisition Practices**		**Innovative Commercial Entity**	
Key Point	Measure	Reasoning	Score	Reasoning	Score	Reasoning	Score	Reasoning	Score	Reasoning	Score
Risk-1	Idea Prototyping	Possible if funding allows	2	Utilizes contracts and contractors to develop and execute quickly	3	Utilizes contracts, funds transfers, and contractors to develop and execute quickly	3	Utilizes contracts, funds transfers, and contractors to develop and execute quickly	3	Complete control to execute	3
Risk-2	Idea Transition	Some ability if funding and timeline allow for effective prototype build and testing	2	Can support some transition to warfighter directly, and work with Program Offices for longer term transition	2	Transition authority with joint approvals needed, which can cause complications	2	Transition authority	3	Requires government approval and partnership made by demonstrations or lobbying	1
Risk-3	Testing	Some ability and typically local facilities, but funding and schedule limit ability to actually test	1	Directly funds and executes testing with Contractor	3	Directly funds and executes testing with contractor and government entities, but joint requirements may complicate or greatly expand testing and timelines	2	Directly funds and executes testing with contractor and government entities for service needs	3	Can test most capabilities, but will require government help to fully test systems for warfighter	2
Risk-4	Ability to Mitigate	Minimal to no capability with limited budget and resources	0	High ability with contractor and risk mitigation planning	3	High ability with contractor and/or governmental entities and risk mitigation planning, but may be complicated with unique service needs or requests	2	High ability with contractor and/or governmental entities and risk mitigation planning	3	High capability to mitigate	3
Usefullness-1	Ability to Transition	Minimal and idea likely to need rework to meet true needs due to limited budgets and resources	1	Can support some transition to warfighter directly, and work with Program Offices for longer term transition	2	Transition authority	3	Transition authority	3	Requires government approval and partnership made by demonstrations or lobbying	1
Usefullness-2	Ability to Mass Produce	None without external funding or assistance	0	Some with commercial partnerships and transitions to program offices	2	High capability with execution plan and contracts	3	High capability with execution plan and contracts	3	Complete control to execute	3
		TOTAL	23		43		30		43		40

Table 10. Kelly Johnson's Fourteen Rules Raw Scoring Data

14 Rule Comparison Analysis

		Naval Surface Warfare Center Dahlgren		**DoD Innovative Group (DIU, DIB, etc.)**		**Department of Defense Joint Effort**		**Department of Defense Service Specific Program Office Using Rapid Acquisition Practices**		**Innovative Commercial Entity**	
Rule	Rule Description	Reasoning	Score	Reasoning	Score	Reasoning	Score	Reasoning	Score	Reasoning	Score
1	Manager Has Complete Control Over Program and Reports Directly to Organization Leadership	Matrix organization, multiple layers of management	1	Manager must utilize Government Contracting Rules and Regulations, but Group works directly with Contractor	2	Manager must utilize Government Contracting Rules and Regulations; Joint implies many stakeholders and layers of management	0	Manager must utilize Government Contracting Rules and Regulations, but Office works directly with Contractor	2	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
2	Small, Strong Combined Contractor/Government Project Office	Minimal internal team due to lack of funding; separate project offices	1	Group works directly with contractor	2	Unlikely to be a small or strong office with multiple services	0	Office works directly with contractor and is very knowledgeable in execution practices	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
3	Small, Capable Project Team	Little or minimal innovation funding likely to produce knowledge gaps	1	Contractor determines team within approved budget	3	Contractor and/or multi-service development team unlikely to be small or co-located	0	Contractor determines team within approved budget	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
4	Simple Configuration Management with Agile Update Capability	Little funding, matrix organization, partial agile process implementation	1	Contractor likely determines Configuration Management and Group must have knowledge base to properly define too. Good contracting practice will protect Government Data rights.	3	GAO reports typically show a lack of configuration management, and each service likely to have their own processes/systems	0	Contractor likely determines Configuration Management with knowledgeable Office. Good contracting practice will protect Government Data rights.	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
5	Minimal and Strategic Reporting	Continuous reporting requirements for funding, multiple levels of organization	0	Contractor and Group report directly to each other	3	Each service will require reports	0	Contractor and Office report directly to each other; Office reports to Service	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
6	Routine Cost Review and Continuous Total Cost Tracking	Navy cost tracking, known to lag; minimal management funding	1	Contract defined reporting for Contractor	2	Each service likely to require different measure and use different accounting systems	0	Contract defined reporting for Contractor and Office maintains Government requirements with continuous assessment	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
7a	Contractor or Project Team Assumed Risk Responsibility and Can Properly Own Risk	Team will own all risk but unlikely to have budget or schedule to properly mitigate or track	0	Contract defined and properly funded	3	Team will assume risk, but risks likely to be different for each service needs and requirements	1	Contract defined, properly funded, and risk management process and plan established for both Contractor and Government	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
7b	Commercial or Government Contracting Practices	Government practices, which have to flow through Dahlgren and NAVSEA	1	Government Practices using latest DoD 5000 authorities which can expedite efforts	2	Government practices, and likely through multiple services	1	Government Practices using latest DoD 5000 authorities which can expedite efforts and likely with contracting officer or authorities	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
8a	Defined, Testable Requirements	Minimal funding prevents appropriate investment in requirements development	0	Contractor defined, but may change to transition	2	Contractor will define requirements, and services will likely change their requirements as program develops	0	Contractor defined and Government/Office approved to ensure warfighter needs met	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3

14 Rule Comparison Analysis

		Naval Surface Warfare Center Dahlgren		**DoD Innovative Group (DIU, DIB, etc.)**		**Department of Defense Joint Effort**		**Department of Defense Service Specific Program Office Using Rapid Acquisition Practices**		**Innovative Commercial Entity**	
Rule	Rule Description	Reasoning	Score	Reasoning	Score	Reasoning	Score	Reasoning	Score	Reasoning	Score
8b	Approved Inspection and Test Plan	Funding and associated management restrictions unlikely to produce test plans; testing at government facilities is expensive	0	Contractor defined and Group must have proper knowledge base to agree to	2	Each service likely to require different testing and change testing requirements or demonstration during development	0	Contractor defined and Office approved to meet warfighter needs	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
9	Iterative Testing and Demonstrations	Minimal funding will limit testing, prototyping, and demonstrations	0	Contractor defined, but likely to be expanded for transition which will increase budget, schedule, and scope	2	Contractor defined, but services likely to change testing and demonstration requirements	0	Contractor defined and Office approved to meet warfighter needs	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
10	Defined, Testable Specifications (Requirements)	Minimal funding prevents appropriate investment in requirements development	0	Contractor defined, but may change to transition	2	Contractor will define requirements, and services will likely change their requirements as program develops	0	Contractor defined and Office approved to meet warfighter needs	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
11	Timely and Appropriate Funding	Continuing Resolutions and minimal innovation funding	0	Continuing Resolutions likely to have impacts, but can be partially mitigated with planning; schedule impact	2	Likely to have adequate funding, but highly likely to be impacted by Continuing Resolutions and Service needs; schedule impacts	2	Continuing Resolutions likely to have impacts, but can be partially mitigated with planning; schedule impact	2	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
12	Government/Contractor Trust and Strong Working Relationship	Minimal funding and contracting rules/regulations heavily structure relationship	1	Group and Contractor direct communications with Government Contracting Rules	2	Multiple government stakeholders unlikely to maintain a strong relationship	0	Office and Contractor direct communications with Government Contracting Rules	2	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
13	Security Awareness, Facilities, and Requirements	Minimal to no infrastructure investment; must use existing infrastructure	1	Contractor defined, but Group/ Transition partner may impose additional security requirements	2	Facilities likely to be adequate, by requirements very likely to change or be unique to each service	0	Contractor and Office approved as part of initial requirements	3	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
14	Individual Performance Incentives	None or little typically based on number of personnel or budget managed; government pay restrictions and tight funding	0	Largely a group of commercial or prior military service contractors, executing contracts and thus able to be rewarded	3	Little to none for group; potential for contractors to be provided incentives from company	1	Little to none for group; potential for contractors to be provided incentives from company	1	Skunk Works or Self-Governed Commercial Entity Following 14 Rules	3
		TOTAL	8		37		5		43		48

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