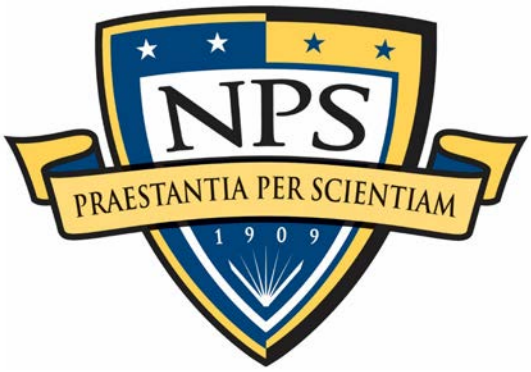

NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

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TEACHING INNOVATION: DESIGNING A CURRICULUM TO CHANGE THE MILITARY

by

Adam B. Wieser

June 2020

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The United States Department of Defense's relationship with innovation has changed from the Cold War–era paradigm of large defense contractors and government think tanks undertaking the lion's share of the responsibility to improve our products and processes. Commercial companies are developing the most advanced technologies, not for the military, but for the individual consumer. The responsibility to innovate has shifted to the military, and it is falling behind. To bring our force up to the level required to remain the world's most advanced fighting force, we need to educate our personnel on how to innovate for themselves. This paper identifies the structure and the content of a curriculum designed to teach innovation. Through research of current programs and innovation theory, a successful innovation curriculum is one that is designed around project-based learning, bridges military organizations with the commercial and academic realm, and teaches the fundamentals of innovation. These fundamentals are centered around an understanding of the current innovation ecosystem, complex problem analysis, innovation diffusion and adoption, and design thinking. Utilizing this curriculum, the Department of Defense can receive an immediate return on its investment through completed student projects and a means to change the culture of innovation throughout the organization toward more self-reliance.

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TEACHING INNOVATION: DESIGNING A CURRICULUM TO CHANGE THE MILITARY

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ABSTRACT

The United States Department of Defense's relationship with innovation has changed from the Cold War–era paradigm of large defense contractors and government think tanks undertaking the lion's share of the responsibility to improve our products and processes. Commercial companies are developing the most advanced technologies, not for the military, but for the individual consumer. The responsibility to innovate has shifted to the military, and it is falling behind. To bring our force up to the level required to remain the world's most advanced fighting force, we need to educate our personnel on how to innovate for themselves. This paper identifies the structure and the content of a curriculum designed to teach innovation. Through research of current programs and innovation theory, a successful innovation curriculum is one that is designed around project-based learning, bridges military organizations with the commercial and academic realm, and teaches the fundamentals of innovation. These fundamentals are centered around an understanding of the current innovation ecosystem, complex problem analysis, innovation diffusion and adoption, and design thinking. Utilizing this curriculum, the Department of Defense can receive an immediate return on its investment through completed student projects and a means to change the culture of innovation throughout the organization toward more self-reliance.

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I. INTRODUCTION

Innovation has been at the heart of state defense since the birth of human conflict. Innovation led the journey from rudimentary clubs, to weapons like the crossbow and sword, to firearms, missiles and the hydrogen bomb.[1] While these innovation had countless others along the way, and took centuries to evolve, the commercialization and industrialization of war attained "runaway velocity" in recent centuries.[2] Weapons, however, are only the most visible of human warfare advancement. Our organizations, training, tactics, and culture surrounding warfare have undergone dramatic innovation as well.[3] Heraclitus' observation "the only constant in life is change" rings especially true in the forces dedicated to the defense of a state, resistance to which has led to the demise of many nations and cultures. There are myriad examples of nations failing to adapt to changing technology or tactics that ultimately leads to their downfall. Likewise, those nations that build their defense on a strategy of readily and quickly identifying and incorporating changes often prevail. That is not to say that militaries must constantly change, for this can be equally detrimental to organizations, especially in times of war.[4] When deciding to change a military's structure, technology, tactics, etc., leaders should carefully consider and plan, and a strategy should be in place for addressing adversary adjustments and changes as well. Like corporations dealing with the challenge of change, military plans must be "plans for *learning* rather than plans for implementation."[5] In other words, we shouldn't focus on specific innovations or best practices; the emphasis should

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[1] Bernard Brodie and Fawn Brodie, *From Crossbow to H-Bomb* (Bloomington: Indiana University Press, 1973).

[2] William McNeill, *The Pursuit of Power: Technology, Armed Force, and Society Since A.D. 1000* (Chicago: University of Chicago Press, 1982), 23.

[3] Jeremy. Black, *War: Past, Present, and Future* (New York: St. Martin's Press, 2003).

[4] Barry R. Posen, *The Sources of Military Doctrine: France, Britain, and Germany Between the World Wars* (Ithaca, NY: Cornell University Press, 1986), 30, http://ebookcentral.proquest.com/lib/ebook-nps/detail.action?docID=3138658.

[5] Clayton M. Christensen, *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* (New York: Collins Business Essentials, 2005), 156.

be on addressing and defining our innovation strategy in a broader sense.[6] Part of that strategy, as with any endeavor to establish a new paradigm, should begin with providing the foundational education to take the necessary steps.

The innovation strategy and its underlying education program should include not only what to innovate, but also how, when, and to what degree. Leaders in our military need the necessary skills and knowledge to make educated decisions regarding innovations and their implementation. Most importantly, "at what point does it make sense to invest in new innovations, given that the costs (financial as well as organizational, doctrinal, and political) may be high and the payoff uncertain?"[7] Leaders with an education in the theories and practices of innovation will be better set up to answer these questions. Furthermore, they will be better suited to bring these changes to the military when necessary.

The U.S. military as with any large corporation, is notoriously stubborn to change, especially drastic change.[8] As Bialos states, "the Department's (DOD) culture is inherently change-resistant to the introduction of new and innovative capabilities."[9] Well-established bureaucracies, processes, and organizations make change a logistical difficulty and if not carefully navigated, can often create more harm than good.[10] Some argue that change in military organizations is so difficult that it requires external impetus from political leaders or interservice competition; internal motivators are simply not enough to push through barriers.[11] Practices and processes entrenched in the culture exacerbate the problem, making change extraordinarily difficult.[12] To overcome these difficulties, the Department

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6 Gary P. Pisano, "You Need an Innovation Strategy," *Harvard Business Review*, June 1, 2015, https://hbr.org/2015/06/you-need-an-innovation-strategy.

7 Emily Goldman and Leslie Eliason, *The Diffusion of Military Technology and Ideas* (Stanford, California: Stanford University Press, 2003), 2.

8 Terry Pierce, *Warfighting and Disruptive Technologies: Disguising Innovation* (London, England: Frank Cass, 2004), 23.

9 Jeffrey Bialos, "Against the Odds; Driving Defense Innovation in a Change-Resistant Ecosystem," February 2017, ix, https://csis-prod.s3.amazonaws.com/s3fs-public/event/170519_against_the_odds_report_0.pdf.

10 Posen, *The Sources of Military Doctrine*, 30.

11 Pierce, *Warfighting and Disruptive Technologies: Disguising Innovation*, 3; Adam Grissom, "The Future of Military Innovation Studies," *Journal of Strategic Studies* 29, no. 5 (October 1, 2006): 908.

12 Christensen, *The Innovator's Dilemma*, 170.

of Defense (DOD) needs a strategy with requisite education that includes a recipe and pathway for implementing change within its sub-organizations.

A. CHANGING HOW THE DOD THINKS ABOUT INNOVATION

While the importance or necessity for United States DOD innovation has not changed, the dynamics have. Large, state actors no longer make up the bulk of our conflicts, and while our warfighting strategy has changed to accommodate this, our innovation strategy has not. Non-state actor groups occupying more and more of U.S. resources and efforts necessitate a change in our innovation strategy. Furthermore, technological advancements have created force-multiplying effects for groups which have until recently been unable to dramatically affect U.S. security; "Due to the persistent innovation enabled by the internet, non-state actors are gaining access to technologies that allow them to achieve parity at the state and regional governance levels."[13] Previous U.S. innovation strategy, especially during the cold war, leveraged large defense contracting organizations, civilian universities, and thinktanks.[14] These organizations, and the relationship between government and these civilian organizations, were generally geared toward a slow, methodical process of building new weapons technology to counter peer adversaries. However, this legacy system may no longer be working and may be eroding U.S. capabilities.[15] Fortunately, the problem is beginning to surface and we are at last "confronting the need for long-overdue changes to how we do business."[16]

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[13] Jennifer Snow, "Entering the Matrix: The Challenge of Regulating Radical Leveling Technologies" (Naval Postgraduate School, Calhoun, 2015), 6, https://calhoun.nps.edu/handle/10945/47874.

[14] Audra Wolfe, *Competing With the Soviets; Science, Technology, and the State in Cold War America* (Baltimore: Johns Hopkins University Press, 2013); Jacques Gansler, *Democracy's Arsenal: Creating a Twenty-First-Century Defense Industry* (Cambridge, MA: MIT Press, 2011).

[15] Chuck Hagel, "Secretary of Defense Memorandum," November 15, 2014, https://archive.defense.gov/pubs/OSD013411-14.pdf; Jeffrey Bialos and Stuart Koehl, "What America's Big New Defense Plan Gets Wrong," The National Interest, June 1, 2016, https://nationalinterest.org/feature/what-americas-big-new-defense-plan-gets-wrong-16421; Jason M. Brown, "Why the Military Needs a Technology Revolution," *The National Interest* 81 (May 31, 2017), https://nationalinterest.org/feature/why-the-military-needs-technology-revolution-20933; Marcus Weisgerber, "Slow and Steady Is Losing the Defense Acquisition Race," Government Executive, accessed August 27, 2019, https://www.govexec.com/feature/slow-and-steady-losing-defense-acquisition-race/.

[16] Zachery Brown, "All This 'Innovation' Won't Save the Pentagon," *Defense One*, April 23, 2019, https://www.defenseone.com/ideas/2019/04/all-innovation-wont-save-pentagon/156487/.

In 2014, Secretary of Defense Chuck Hagel began the Defense Innovation Initiative, designed to "pursue innovative ways to sustain and advance our military superiority for the 21st Century."[17] Numerous programs and ideas stemmed from this effort, including a revamped ideology incentivizing failure as a step to success embodied by the Defense Innovation Unit, utilizing minimum viable product strategies espoused by Hacking for Defense, the Long-range Research and Development Planning Program, and other service-specific "innovation units."[18] Furthermore, strategic leadership put in place strategic guidance reinforcing the importance of bolstering DOD innovation focus. In its goal to "organize for innovation," the 2018 *National Defense Strategy* states, "The Department's leadership is committed to changes in authorities, granting of waivers, and securing external support for streamlining processes and organizations."[19] If a revolution in our innovation strategy is so important, and many have identified the need, it seems logical that building a personnel base knowledgeable in innovation would be a critical step.

The current DOD education efforts focus on historical examples of innovation and doctrinal changes; however, there is little concerned with identifying *how* to affect change in the DOD. An education system that can provide this critical foundation is fundamental to building a long-term strategy of innovation that can adapt to current and new adversaries.[20] This paper seeks to identify the key factors for this innovation education and the pedagogical approach we should use to facilitate and promote an organization armed with the knowledge to transform the DOD. Designing the education for innovation with carefully crafted concepts and characteristics will ultimately provide the DOD with the change agents needed to take our force into the next 50 years.

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17 Hagel, "Secretary of Defense Memorandum."

18 "Defense Innovation Initiative," Defense Innovation Marketplace, accessed January 8, 2020, https://defenseinnovationmarketplace.dtic.mil/wp-content/uploads/2018/04/DefenseInnovationInitiative.pdf; Ben Fitzgerald, "The DIUx Is Dead. Long Live The DIUx," *Defense One*, May 12, 2016, https://www.defenseone.com/ideas/2016/05/ash-carter-diux-pentagon-technology-innovation/128254/; Thomas Holland, "How the Army Ought to Write Requirements," *Military Review* 97, no. 6 (2017): 100–105.

19 Department of Defense, *Summary of the 2018 National Defense Strategy* (Washington, DC: Department of Defense, 2018).

20 Williamson Murray, "Innovation: Past and Future," ed. Williamson R. Murray and Allan R. Millett, *Joint Forces Quarterly*, summer 1996, 30, https://doi.org/10.1017/CBO9780511601019.009.

The DOD is going to have to bring the responsibility for innovation back to the force. This is going to require a bottom-up approach, ensuring our personnel at every level are educated on how to innovate. The National Military Strategy 2015 identifies the importance of education in the overhauling of our innovation strategy; "To retain our warfighting edge, we are stressing innovative leader development across the All-Volunteer Force... Continuous, demanding education inspires new ideas and identifies better ways to accomplish our missions."[21] The next step is to build this education and ensure it works to support the strategy; our military academic institutions are the place to start.

B. PURPOSE

Ultimately, this paper seeks to provide a pathway to develop education for our personnel on military innovation which is the first step to inculcating a widespread culture of innovation across the DOD. Due to the current scarcity of innovation curriculum in the DOD, our strategy has stagnated. Rapidly evolving innovation methods and strategy require personnel with an education in how to affect change in their organizations. This will help foster new and improved warfighting capabilities. While there is abundant literature on empirical examples of innovation in both the private and public sectors, the external causes, and the need for education, there is little on the composition of the education. Building on previous work by Dan Fiack and Philip Riglick,[22] this paper outlines the necessary concepts of successful innovation and uses these to develop the pedagogical approach for a DOD innovation curriculum.

The objective of the paper is thus two-fold. First, it provides visibility and evidence to readers inquiring into the efficacy of innovation education, strengthening the argument that a robust knowledge base is fundamental to changing DOD's innovation strategy. Second, it will provide a framework for such an educational effort and the necessary concepts that such a curriculum of learning should address to be successful. While there

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[21] Joint Chiefs of Staff, *The National Military Strategy of the United States of America* (Washington, DC: Joint Chiefs of Staff, 2015), 14, https://www.jcs.mil/Portals/36/Documents/Publications/National_Military_Strategy_2015.pdf.

[22] Philip Riglick and Daniel Fiack, "Applied Design for Innovation" (master's thesis, Monterey, CA, Naval Postgraduate School, 2019).

are few military-specific programs to use as examples, public sector innovation curricula can provide guidance and multiple possible approaches. Combining these approaches with some intricacies and requirements of the DOD yields a baseline for the DOD to utilize in several different ways to facilitate an educated personnel core.

The intent, however, is not to define the specific courses of instruction. There are numerous avenues that the DOD can take to execute an innovation curriculum, so prescribing specific course material would not provide the latitude necessary and is not the goal of this paper. Instead, I will attempt to present key concepts and experiences that an innovation curriculum should encapsulate. Using these concepts, our academic institutions can tailor classes or initiate new courses that ensure students are receiving all of the necessary knowledge and experiences. Ultimately, the recommendations in this paper attempt to be flexible enough to apply to a range of academic environments including in-resident and online, as well as to different skill levels from individual certificates to a master's program.

C. RESEARCH QUESTIONS

Upon completion of an initial literature review, two overarching questions remain. The questions revolve around two components of a successful curriculum: structure and content. First, what does the overall pedagogy for a curriculum designed to teach military innovation look like; what framework provides the best foundation for inculcating personnel with the concepts, experience, and knowledge that allows them to navigate the DOD innovation ecosystem. Classroom-based learning is not sufficient to provide a well-rounded understanding of the current innovation initiatives and processes necessary to effect change in the DOD. A mix of academic education, hands-on experience, and access to external networks is essential to develop personnel with the required skills. Second, within that framework, what should be the content of the academic instruction. What are the concepts that students need to learn, and how do they build a well-rounded understanding of military innovation?

D. APPROACH

Most of the literature on innovation comes from the commercial realm. Additionally, civilian institutions are leading the way toward making innovation a well-grounded subject for academic instruction. However, the DOD can easily apply the concepts to our own organizations. This paper will develop the basis for the structure and content of an innovation curriculum using historical examples, literature surrounding innovation from multiple angles, and civilian institution examples with current innovation programs. Innovation takes many forms; there are varying relationships with it, and even more preferred ways to implement and foster it. People apply the concept of innovation broadly across organizations and attack it from many different angles depending on the situation. This paper will attempt to combine these different approaches into general components that seem to encompass most innovation thinking. Providing students with multiple points of view and perspectives will allow them to apply innovation to a broader range of aspects within their organizations.

E. ORGANIZATION

This paper is divided into five chapters, covering general innovation concepts and moving into innovation education. Chapter two provides an overview of the varying definitions and concepts surrounding the over-arching term "innovation." I will consider the essential components of innovation, providing the operationalization of the term that is necessary to navigate the issue space. The third chapter will outline some of the innovation curricula currently offered at civilian academic and DOD institutions. Chapters four and five use the lessons and concepts identified in chapters two and three to build arguments to support the design of an innovation curriculum. Specifically, chapter four deals with the structure of the academic experience. Classroom lecture alone is not going to provide the student with the best educational experience, hands-on work through projects, internships, and exposure to the innovation ecosystem will result in a better end-product. The fifth chapter attempts to provide the necessary components of the academic instruction portion of the curriculum. I will identify key objectives we should expect innovation-focused graduates to understand and why do they need to know them. The objectives broadly follow

the areas of innovation fundamentals, the defense innovation ecosystem, problem curation and dealing with complex problems, design thinking, and challenges of implementation and adoption. Finally, the last chapter identifies the way forward for innovation within the DOD; what work still needs to be done to change the DOD culture toward innovation and build an organization that is ready for a dynamic future warfighting environment.

II. DEFINING INNOVATION

The literature on innovation encompasses a broad range of ideas surrounding innovation. The purpose of this chapter is not to determine a "best" definition, nor does it seek to rebuke other definitions. However, to determine the most essential components of an innovation curriculum, a necessary first step is to arrive at a consensus on the nature of innovation and what it means in the context we are applying it. This section will also serve as a literature review, identifying the most prevalent ideas surrounding innovation.

While there are many differing views on what exactly constitutes "innovation," we will use a definition aimed at incorporating multiple aspects of innovation that we can also apply to military applications. *Innovation is the process by which a new and improved practice is developed and adopted by a group.* This definition is derived from the literature on the subject, which argues for several principles regarding the characteristics of innovation, which follows.

The development of an innovation is a process. It is about taking ideas from "inception to impact."[23] Just as learning to ride a bike takes patience, trial, and error, one cannot expect to have an idea and immediately render it a successful innovation. Often, the new practice requires multiple iterations, fine-tuning details, experimenting, and building support until it is considered successful. Fariborz Damanpour reinforces the conception of process-based innovation, noting that innovation is "conceived as a process that includes the generation, development, and implementation of new ideas or behaviors."[24] Some of the literature tries to define the precise stages in the innovation cycle; however, the primary point here is that there are in fact stages to innovation, it is not simply a one-step activity.[25]

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[23] Fiona Murray and Phil Budden, Deep-Diving MIT Sloan's Innovation Approach, December 9, 2019, https://www.iedp.com/articles/deep-diving-mit-sloan-s-innovation-approach/.

[24] Fariborz Damanpour, "Organizational Complexity and Innovation: Developing and Testing Multiple Contingency Models," *Management Science* 42, no. 5 (May 1996): 693–716.

[25] Everett M. Rogers, *Diffusion of Innovations*, 5th ed. (New York: Free Press, 2003); Damanpour, "Organizational Complexity and Innovation: Developing and Testing Multiple Contingency Models"; Sara L. Beckman and Michael Barry, "Innovation as a Learning Process: Embedding Design Thinking," *California Management Review* 50, no. 1 (Fall 2007): 25–56, https://doi.org/10.2307/41166415.

This is not to say that the stages must be sequential or a prerequisite for the next to begin.[26] Another way to think about it is presented by Tim Brown, who writes "innovation is a system of overlapping spaces rather than a sequence of orderly steps."[27] Innovation is often a messy, non-linear process, attempting to treat it otherwise is counterproductive.[28] However, these authors agree that innovation must pass through a multi-step process to be successful.

This important concept of a multi-step process differentiates innovation from invention. Typically, an inventor can complete an invention with little or no ambition to solve an actual problem or get people to adopt it, this is not so with innovations. A common misunderstanding is that invention and innovation are synonymous. Unfortunately, this view fails to comprehend that inventions themselves have not *changed* anything, for this to occur they must first be put into use. As Denning and Dunham point out, there is a multitude of inventions like the Betamax system that never actually became innovations.[29] Furthermore, innovations are often stimulated by people other than inventors; too much focus on invention "is a major factor in the low success rate of innovation."[30]

We should accept the idea that innovation is a process because it lends to developing a better strategy for its implementation. Focusing on the entire process allows us to build organizations that know how to translate product development to warfighting capability. In defending the importance of a process-based approach, rather than just making products Kelly explains "processes—the engines of flux—are now more important than products" and human cognitive evolution focusing on processes over products "was a million times better than inventing any particular product, because process generated a

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[26] Christoph Zott and Raffi Amit, "Business Model Innovation: Toward a Process Perspective," in *The Oxford Handbook of Creativity, Innovation, and Entrepreneurship*, ed. Christina Shalley, Michael Hitt, and Jing Zhou (New York, New York: Oxford University Press, 2015), 401.

[27] Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. (New York: Harper Business, 2009), 16.

[28] Bialos, "Against the Odds," 6.

[29] Peter J. Denning and Robert Dunham, *The Innovator's Way: Essential Practices for Successful Innovation* (Cambridge, MA: MIT Press, 2010), 9.

[30] Denning and Dunham, 8.

million new products over the centuries."[31] We should continue to reinforce the idea that innovation is not a one-step activity, it is a process we should be continually involved with. The unproductive notion that innovation is not a continual process often leads to another fallacy, that innovation and technology are synonymous.

Innovation is concerned with new practices, not simply new technology. While technology plays a role in some innovations, history shows that "technological determinism" leaves out important components of change.[32] Most literature advocates the need for innovation to focus on the change to the underlying practice or process, not solely on technology.[33] This important distinction is critical for developing an innovation curriculum as well as a national innovation strategy. Too much focus on the pursuit of advanced, yet unsuitable technology may be ineffective in producing the desired results. Mahnken reaffirms this argument, finding that with few exceptions successful relationships with technology are those where the organization molds the technology to fit the purpose, rather than pursuing technology and subsequently finding a purpose to fit.[34] In a similar stance, Bialos finds that "successful innovation is not merely about technology, but the ability to effectively utilize that technology in modern warfare, from doctrine to organization to operations to tactics and training."[35] Technology can be a catalyst for innovation but only to the degree that it affects the underlying process. Pierce notes, "The mistaken belief that technological breakthroughs can win wars fails to recognize the

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[31] Kevin Kelly, *The Inevitable: Understanding the 12 Technological Forces That Will Shape Our Future* (New York: Viking, 2016), 6.

[32] George Raudzens, "War-Winning Weapons: The Measurement of Technological Determinism in Military History," *The Journal of Military History* 54, no. 4 (1990): 403; Merritt Smith and Leo Marx, eds., *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press, 1994); Black, *War: Past, Present, and Future*.

[33] Denning and Dunham, *The Innovator's Way: Essential Practices for Successful Innovation*, 6; Pierce, *Warfighting and Disruptive Technologies: Disguising Innovation*, xii; Clare Farrukh, David Probert, and Robert Phaal, "Getting Value From Technology: A Process Approach," in *Managing Innovation Driven Companies : Approaches in Practice*, ed. Hugo Tschirky et al. (New York: Palgrave Macmillan, 2010).

[34] Thomas Mahnken, *Technology and the American Way of War Since 1945* (New York: Columbia University Press, 2008).

[35] Bialos and Koehl, "What America's Big New Defense Plan Gets Wrong."

importance of doctrine and organization in translating technology into advantage."[36] Even states that are "first movers" in a technology but don't translate it into a war-fighting innovation will fail to gain superiority; the importance lies in the employment of the technology, not the technology itself.[37] From a commercial business perspective, Christenson determines that when dealing with innovations, a company's success depends on "firms to change strategies and cost structures, not technologies."[38] But the idea is not unique to the public sector, it crosses to the DOD as well.

The idea in the DOD that a new piece of technology is synonymous with innovation is a prevalent one, often creating uncalculated searches for the next best piece of tech without regard to its efficacy or feasibility. Like innovation in the commercial sector, military innovation requires more than technology. According to Cohen, revolutionary change in war comes from more than new technology, organizations have to utilize them correctly to gain an advantage; "it not merely the tools of warfare but the organizations that wield them that make for revolutionary change in war."[39] Cheung, Mahnken, and Ross agree that many people equate technology with innovation because it is the most visible piece; however, military innovation should never be "equated with, or reduced to" technology.[40] Jason Brown argues for the DOD to rethink the way we use new technology, stating that "resting on laurels or technology that our rivals are copying will no longer suffice."[41] Even DOD leadership is aware of the current ineffective technology focus; "Success no longer goes to the country that develops a new technology first, but rather to the one that better integrates it and adapts its way of fighting. Current processes are not responsive to need."[42] This is not to say that technology is inconsequential, innovators

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[36] Pierce, *Warfighting and Disruptive Technologies: Disguising Innovation*, xii.

[37] Michael Horowitz, *The Diffusion of Military Power Causes and Consequences for International Politics* (Princeton, NJ: Princeton University Press, 2010), 10.

[38] Christensen, *The Innovator's Dilemma*, 55.

[39] Eliot A. Cohen, "A Revolution in Warfare," *Foreign Affairs; New York*, April 1996.

[40] Tai Ming Cheung, Thomas G Mahnken, and Andrew L Ross, "Assessing the State of Understanding of Defense Innovation," *SITC Research Briefs*, May 1, 2018, 5.

[41] Brown, "Developing an Innovation Based Ecosystem at the U.S. Department of Defense."

[42] Department of Defense, *Summary of the 2018 National Defense Strategy*.

surely must consider advances in technology as part of a successful strategy. However, an effective approach to innovation necessitates a comprehensive view of multiple factors that affect change.[43] A successful view of innovation should be built around the idea that technology is not enough, it is about improving the underlying practice or process, which leads to the next fundamental concept surrounding innovation.

Innovation must improve upon the previous practice in place. As discussed earlier, there are clear differences between inventions and innovations, this is another. While an invention only requires newness, an innovation requires some improvement upon the previous practice in place. This characteristic of innovation clarifies what most people think of when they think innovation, change. However, it is more than just change; change in itself happens routinely and can have negative consequences. Instead, the concept we are concerned with is that which produces an increase in effectiveness, efficiency, or some other metric. Change not just for newness, but for improvement. As Christenson explains, the new practice must be "of greater value."[44] In a military context, this means an increase in military effectiveness and capability.[45] Pierce agrees, stating that innovation requires an "improved performance along a warfighting trajectory."[46]

Even though innovation requires improvement in some metric, the degree to which it improves is not necessary for the purposes of this paper. We will accept the idea that academics should focus on the tools for innovation in general, regardless of the effects the innovation has. However, an important distinction for education lies in identifying *types* of innovation. The differing types of innovation require different organizational strategies for development and implementation; thus, they will require an academic instruction that addresses the differences. The innovation types follow two pathways, those that improve upon a preexisting practice and those that create an entirely new practice that disrupts the competitor's current way of thinking and acting. These two categories, called sustaining

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[43] Jeremy Black, *War and Technology* (Bloomington: Indiana University Press, 2013), 54.

[44] Christensen, *The Innovator's Dilemma*, xiii.

[45] Grissom, "The Future of Military Innovation Studies"; Horowitz, *The Diffusion of Military Power Causes and Consequences for International Politics*, 31.

[46] Pierce, *Warfighting and Disruptive Technologies: Disguising Innovation*, 1.

and disruptive, were developed by Christenson but have since become prevalent throughout much of the literature.[47] Christenson explains the difference between the two is how they change the "established trajectories." Sustaining innovations "improve the performance of established products," while, disruptive innovations "disrupted or redefined performance trajectories."[48] While Christenson and Geroski explain these terms in the commercial business context, Terry Pierce adopts them to a military context. He notes that the difference in sustaining innovations result in an "improved performance along a warfighting trajectory that traditionally has been valued," while disruptive innovations affect those trajectories that have not previously been valued.[49] In other words, sustaining innovations change a preexisting practice, while disruptive innovations develop a new one. The distinction between these two types of innovation is important because, especially in a military context, they are handled differently.[50] Most notably, disruptive innovations have a distinct first-mover advantage.[51] The nation that adopts them first is able to improve them rapidly and create asymmetrical conditions where the adversary is forced to quickly develop a counter or suffer the consequences. Sustaining innovations, on the other hand, do not create this new dimension for adversaries. Disruptive and sustaining innovations have important distinctions that are important to consider, however, neither type of innovation can be successful without it first being adopted and implemented throughout a group.

Finally, innovation requires adoption by a group. This final characteristic of innovation, adoption, presents perhaps the most challenging obstacles. Even if the innovation offers clear advantages, adoption can be difficult.[52] It is not enough if one

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[47] Christensen, *The Innovator's Dilemma*; Paul Geroski, *The Evolution of New Markets* (Oxford, England: Oxford University Press, 2003).

[48] Christensen, *The Innovator's Dilemma*, 9. For a more detailed discussion on the definition of disruptive innovations see work by Delmer Nagy, Joseph Schuessler, and Alan Dubinsky in "Defining and Identifying Disruptive Innovations" *Industrial Marketing Management* 57, C (2016): 119–126

[49] Pierce, *Warfighting and Disruptive Technologies: Disguising Innovation*, 1.

[50] Pierce, xii.

[51] Christensen, *The Innovator's Dilemma*, xxii; Cheung, Mahnken, and Ross, "Assessing the State of Understanding of Defense Innovation," 2.

[52] Rogers, *Diffusion of Innovations*, 1.

person or a small subsection of an organization implement the new product or process, that is not what has true impact, neither does it truly make an innovation. An improved practice that could result in significant advantages to a defense force is worthless unless organizations wholly diffuse, adopt and implement it into standard practice. Rouse explains "not only do we want to introduce such things—we want people to change past patterns of behavior and both accept and endorse these new things."[53] This at first seems like an obvious characteristic, however, failing to get the organization to fully adopt the new practice is a primary cause of failed innovations. Talukder notes that even if the innovation offers some benefit, the "performance gains are often obstructed by users' unwillingness to accept and use the available innovation."[54] The Department of Defense is no exception when considering the difficulty of adoption. In a statement to the House Armed Services Committee, Dr. Eric Schmidt commented on the problems with the DOD and innovation, "DOD does not have an innovation problem; it has an innovation adoption problem."[55] If the DOD wants to change its innovation strategy, focusing on how we think about adopting new ideas will be vital. All of the above principles will be important to develop the structure and content of an innovation curriculum, but first we will look at the current innovation education landscape to include programs offered by other institutions to understand how and where the DOD curriculum will fit in.

[53] William B. Rouse, *Catalysts for Change: Concepts and Principles for Enabling Innovation*, Wiley Series in Systems Engineering (New York, New York: Wiley, 1993), 3.

[54] Majharul Talukder, *Managing Innovation Adoption: From Innovation to Implementation* (Surrey, England: Gower, 2014), 1.

[55] Eric Schmidt, "Statement of Dr. Eric Schmidt House Armed Services Committee," § House Armed Services Committee (2018), https://docs.house.gov/meetings/AS/AS00/20180417/108132/HHRG-115-AS00-Wstate-SchmidtE-20180417.pdf.

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III. CURRENT LANDSCAPE OF INNOVATION CURRICULA

To build a military innovation curriculum, it is important to have a basic understanding of what is currently offered in both the civilian and military sectors. This chapter will take a brief look at the current landscape of innovation education. As has been discussed, innovation has broad interpretations and applies to different industries, organizations, and situations uniquely. Of note, I am not advocating for the mimicking of a specific existing curriculum, nor am I seeking to rank these programs or evaluate the content. Instead, I will use the existing curricula as models of different approaches and identify common practices. In an environment where civilian institutions from multiple industries are leading the way on innovation, perhaps emulating these programs and ideas in our professional military education is appropriate.[56] Additionally, a broad knowledge of other players in the space can provide diversity and a robust network among multiple sectors from which innovation thrives. Finally, military innovation education can gain a lot from maintaining relationships with other academic institutions to fill gaps in knowledge or capability. First, we will look at the general types of innovation education that exists, then we will examine several in-depth.

There are three basic approaches that current academic institutions are using to promote innovation education: degree granting programs, unstructured "innovation centers," and professional-focused certificate programs. First, there are degrees designed specifically to teach innovation. These are aimed at instructing the epistemological and practical skills necessary to foster innovation in individual students as well as their organizations. Second, there are academic institutions that have created "innovation centers" designed to provide a place for students to work with other students as well as external industry on building and implementing new products and processes. The University of Nebraska as well as Virginia Tech have such "innovation campuses" that are good examples of this framework. The University of Nebraska's Innovation Campus is "connecting the talents of experts,

[56] Jennifer Mittelstadt, "Too Much War, Not Enough College," War Room; United States Army War College, June 20, 2018, https://warroom.armywarcollege.edu/articles/too-much-war-not-enough-college/.

companies and the university to create a unique culture of innovation." [57] While these centers don't necessarily offer a specific innovation curriculum, they provide an important resource for students to learn about innovation. By providing the space and networks, students can learn about innovation through direct experience and mentorship; allowing them to take an active role in innovation. The third approach is a certificate-based curriculum designed to provide working professionals with basic innovation skills to implement immediately into their companies. Students can take one or two classes at a time as necessary based on their desires and deficiencies. Stanford and the MA Institute of Technology Sloan Management School both offer this type of approach.[58] While all of these approaches provide a unique way to learn innovation, we are primarily concerned with the first approach since it most closely resembles our intent.

The goal here is to focus on comprehensive innovation curricula so we will narrow the focus to academic programs that provide a degree closely related to innovation. Additionally, the DOD has mirrored the second approach type in organizations like the Defense Innovation Unit and the "WERX" model (SOFWERX, AFWERX, DEFENSEWERX) covering some of that gap in the innovation ecosystem. We will look more in detail at three innovation degrees, seeking to identify the pedagogical principles and curriculum design. We will look at the University of Colorado-Colorado Springs's Bachelor of Innovation, the University of San Francisco's Master of Science in Entrepreneurship and Innovation, and finally Hult International Business School's Masters in Disruptive Innovation.

The University of Colorado-Colorado Springs offers a bachelor of innovation with a unique and beneficial design. The degree is designed around a common innovation core and then students can choose from several interdisciplinary tracks to supplement. The tracks are

[57] "Academic Programs," Virginia Tech, accessed February 19, 2020, https://vt.edu/content/innovation_subfolder_cms_vt_edu/en/academic-programs.html; University of Nebraska-Lincoln, "Nebraska Innovation Campus," accessed February 19, 2020, https://innovate.unl.edu/about.

[58] "Stanford Innovation and Entrepreneurship Certificate," Stanford University, accessed February 19, 2020, https://scpd.stanford.edu/public/category/courseCategoryCertificateProfile.do?method=load&certificateId=14800052; "Innovation Certificate," MIT Sloan Executive Education, accessed February 19, 2020, https://executive.mit.edu/executivecertificates/strategy/.

business areas, art and humanities, early childhood education, game design and development, science and engineering, and computer science and security.[59] The primary advantage of this type of degree is that it develops students with a foundation in innovation but with different specialties that can then collaborate internally and externally with industry to bring more viewpoints to a project. The common core consists of 24 credits germane to innovation. Students start their first year with introductory classes that focus on entrepreneurship and innovation principles. One of the first classes, The Innovation Process, "Overviews the key components in the innovation process and examples of major innovations throughout history."[60] Other introductory classes include Introduction to Entrepreneurship, Business Law, and Intellectual Property Law. The second, third and fourth years revolve around a group, interdisciplinary project. Learning comes from work on the project supplemented by classroom instruction. Objectives emphasize analyzing data, reporting, design, execution, and leading team projects. The projects involve students working with partner organizations on proposals that businesses will use immediately.

The next degree comes from the University of San Francisco School of Management. They offer a Master of Science degree in Entrepreneurship and Innovation "designed to ensure new and recent college graduates gain essential skills and experiences to best compete for a place in today's innovation economy and launch a professional entrepreneurial career."[61] It is a one year program consisting of 32 core credits and 4 elective credits. The stated program goals are:

1. Develop cadres of entrepreneurial and innovative leaders who help fashion a more humane world through the creation and development of products, services, and enterprises that serve communities around the globe.
2. Accelerate the students' intellectual and professional growth leading to the launch of new professional careers or new ventures by building business and technical capabilities and professional experiences.

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[59] "World's Only Bachelor of Innovation Degrees," University of Colorado-Colorado Springs, accessed February 19, 2020, https://innovation.uccs.edu/.

[60] University of Colorado-Colorado Springs.

[61] "Master of Entrepreneurship and Innovation - MSEI - Program Details," University of San Francisco, August 19, 2016, https://www.usfca.edu/management/graduate-programs/entrepreneurship-innovation/program-details.

3. Engage students in the Silicon Valley ecosystem through a comprehensive set of curricular and co-curricular programming and activities that introduce students to new professional and entrepreneurial career opportunities.
4. Promote and support the global entrepreneurship and innovation network of current students, alumni, and affiliated external partners that enhance the professional opportunities for all.[62]

The core classes involve topics instructing the philosophy of innovation, creativity and applied design, organizational innovation, entrepreneurial leadership, and strategy and planning. Finally, there are two practicum options designed to utilize the garnered innovation skills in a real-world situation. The school describes the practicum as "Working individually or in small teams, students will complete a defined business project(s) that has both practical value and academic rigor."[63]

With several campuses throughout the world, the Hult International Business School offers a Masters in Disruptive Innovation. The degree is "designed to equip (the student) with both a practical business understanding and the knowledge of how people, technology, and digitization overlap to impact decision-making and organizational change."[64] Core class concepts include design thinking, disruptive business models, managing emerging technologies, entrepreneurial finance, and data literacy in the age of machine learning.[65] Finally, the degree emphasizes "learn by doing" aimed at allowing students to "put theory into practice and gain firsthand experience throughout your degree by working in diverse teams to solve real-world problems."[66] This is done through a "Hult Business Challenge" in which students work on a real-world project integrating with industry. Additionally, as an elective, students are encouraged to take an internship at a local company.

The last degree I will discuss is from the United States Air Force's Air University and is referred to as the "Blue Horizons" program. It is currently the only degree provided

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[62] University of San Francisco.

[63] University of San Francisco.

[64] "Masters In Disruptive Innovation," Hult Business School, accessed February 19, 2020, https://www.hult.edu/en/programs/masters/disruptive-innovation/.

[65] Hult International Business School.

[66] Hult International Business School.

by a DOD institution that is similar to those innovation degrees offered by non-DOD schools. Run by the Air Force Center for Strategy and Technology (CSAT), the program is chartered for "future-oriented study exploring military-technical and geostrategic competition and its implications for Air Force strategy and planning."[67] As a year-long program, students receive a Master of Science in Airpower Strategy and Technology Integration. Courses include metacognition, strategy, technology, international politics, military history, regional studies, and joint capabilities. Additionally, the Chief of Staff of the Air Force provides a current project in innovating the force that students work on as part of the curriculum. The projects, along with academic instruction, "pushes its fellows to work with partners in government, industry, and academia to develop innovative prototypes of organizational constructs, operational concepts, and applications of technology."[68] This program is similar to civilian academic institution programs in innovation and takes a step in a positive direction at providing the DOD with an innovation program of its own, however, it is geared more toward teaching subjects tangential to innovation rather than focusing on *how* to innovate in general.

There are several key takeaways from these programs that can be useful for designing an innovation education. First, each of these academic programs involved some sort of project integrated into the curriculum. Projects help clarify the concepts that students learn in instructional classes. Furthermore, they help students learn by trial and error and allow them to put their thoughts to the test. The important thing to mention here is that these projects are not produced in a vacuum, they are built with customers in mind. This idea generates true innovation rather than students just inventing something. The avenue to accomplish this is to have the students team up with companies that are either fixing part of their processes or making something new for their customers. This ensures that students projects have specific goals in mind. Using projects to bolster the curriculum adds a lot of value; I will address the idea of project-based learning and its benefits as a pedagogical approach in Chapter IV.

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[67] "Blue Horizons IDE/SDE Program," Air University, accessed February 21, 2020, https://www.airuniversity.af.edu/CSAT/Display/Article/1096090/blue-horizons-idesde-program/.

[68] Air University.

Second, there are common broad-based concepts embedded in their courses which include an overview of innovation, leadership in some form, organization dynamics, and design. Additionally, the innovation curricula are generally integrated with entrepreneurship. This can have an impact on a military innovation curriculum as well. However, instead of entrepreneurship, a military curriculum could focus on "intrapreneurship." Similar in focus, although intrapreneurship focuses within an existing organization rather than building a new one.[69] While making an offshoot within a company is not always necessary for innovation, the intrapreneur mindset is beneficial to anyone looking to facilitate all types of change within the organization and should be nurtured by our leaders.[70]

Third, each program included or stressed integration with industry. Either through project work or internships, a fundamental component that the academic institutions stress is the necessity to have students working with business partners. This element of the program gives the students first-hand experience to work with people in the field and see how different companies approach innovation. Not only does this broaden the students' experiences, it also keeps the program relevant by leveraging current, successful companies.

Finally, while these programs seem to be well-received by the academic institutions and graduates' employers, the idea of a degree in innovation is still new but nascent. There are relatively few institutions offering a comparable degree, however it appears to be expanding. This has several implications for building a new degree for the DOD. There is a big opportunity here to be one of the early adopters in this field. This appears to be not only desired by the DOD, but the commercial industry as well. However, this may result in increased resistance to the degree's generation. As with all innovations, this will require a well-defined strategy for implementation, support, and development. We can use these example programs to help with this strategy, additionally we can use them to provide a foundation to build our academic structure, course objectives, and design which we will outline in subsequent chapters.

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[69] Bostjan Antoncic and Robert D Hisrich, "Clarifying the Intrapreneurship Concept," *Journal of Small Business and Enterprise Development* 10, no. 1 (2003): 7–24.

[70] Mike Campbell, "Disruptive Thinkers: Intrapreneurship Vice Entrepreneurship – Why This Distinction Matters," *Small Wars Journal*, accessed April 29, 2020, https://smallwarsjournal.com/jrnl/art/disruptive-thinkers-intrapreneurship-vice-entrepreneurship-%E2%80%93-why-this-distinction-matters.

IV. PROPOSED STRUCTURE OF AN INNOVATION CURRICULUM

The structure of the curriculum is an important consideration, and while it may be tailored based on the academic institution, several factors should remain consistent. We must first begin with an understanding of the overall objectives of an academic innovation program. These differ from learning objectives which I will address in chapter five. Instead, I am concerned here with those broad-based objectives that such a curriculum should achieve, based on strategic guidance. These objectives are as follows, in order of importance:

1. Foster a culture of innovation within the DOD.
2. Bridge gaps between sections of the DOD innovation ecosystem at large to include commercial industry and government contractors.
3. Provide useable solutions to DOD organizations that solve current and future problems.

Establishing a culture of innovation within the DOD is fundamental to achieving the strategic directives from leadership. A paradigm shift is necessary to foster collaborative solutions within the DOD and the larger industrial defense network. Organizations that allow the space and support to try new things and gives permission to fail in search of success are the most successful at promoting new ideas.[71] Our strict adherence to historical practices, lack of incentives and vehicles for change, and a general aversion toward creating quick, useable solutions can only be overcome with a retooling of our culture. One method for remedying this should come from innovation education. Equipping personnel with the knowledge and skills necessary to implement innovation within their organizations will eventually permeate the broader DOD and change the culture. As is true in many areas, education allows personnel to have the confidence and expertise to execute on important and necessary problems.

[71] Brown, *Change By Design*, 32.

Fixing the culture will involve changing the current innovation ecosystem which is quickly becoming fragmented and starting to exhibit the "rice-bowling" endemic to many of the aspects of the military. Many levels of the military bureaucracy have developed their own "innovation cell" or "innovation officer" without the necessary integration with other cells nor the education with which to carry out their tasks. The problem is that services often use resources developing solutions that already exist elsewhere and have no means to share best practices or potential ideas.

While any innovation ecosystem certainly has some inevitable "messiness," it should be at the very least navigable. Our current ecosystem is quickly becoming just the opposite, "This means not only that innovators who want into the ecosystem struggle, but defense and civilian agencies also are in the dark about each other's innovation brokers."[72] While there are several ways to fix this issue, one of the easiest is a mechanism that revolves around working with external agencies and partners that is not beholden to a specific service or organization. A curriculum at a military academic institution can do just this; the academic institution as well as the students within the innovation curriculum can act as a go between among the multiple innovation cells in the military. Building a cohesive ecosystem will help DOD innovation by allowing more collaboration, support, and piggybacking on others' ideas.[73]

By providing a bridge between innovation centers and cells, the academic program can cultivate collaborative effort to produce tangible solutions for the DOD. There are myriad problems in the DOD that need serious and in-depth work to solve, as well as emerging solutions that can advance our force. Having students focus on producing a deliverable project will help them learn the fundamentals of innovation while providing short term return on investment for the DOD. While this is an important objective, I will emphasize that it should never be of primary importance. Innovation is never a sure thing, and failure can provide valuable lessons to both the students and the DOD at large; "In

[72] Anne Laurent, "So Many Innovation Hubs, So Hard to Find Them," *Government Executive*, September 11, 2019, https://www.govexec.com/technology/2019/09/so-many-innovation-hubs-so-hard-find-them/159798/.

[73] Laurent.

practice, failure plays an important role in the pursuit and process of change."[74] Course administrators as well as student should understand that the goal is not necessarily to produce a product, but to learn from the process.

To accomplish these three primary objectives, the curriculum should have three overlapping parts. First, a flexible, comprehensive pedagogical composition designed to teach the ranging issues surrounding military innovation. Second, ensuring students have direct interaction into the DOD innovation ecosystem to include contact with innovation hubs, end-users, and commercial industry. Third, the curriculum should be designed using project-based learning; with hands-on projects to teach the fundamentals of innovation.

A. CLASSROOM INSTRUCTION

The classroom learning portion of the curriculum has several important characteristics. It should be tailorable and flexible, it should contain mechanisms that ensure it remains current, and it should provide enough "whitespace" for students to learn outside of the classroom. Understanding these basic characteristics will help administrators determine what classes should be offered, how many, and to what degree students should have the ability to adjust the curriculum to suit their learning experience.

First, the curriculum should be highly tailorable and flexible enough to accommodate students' aspirations as well as build a student base with more breadth. Innovation is a complex process that can change direction or regress multiple times throughout the cycle. A curriculum that is too rigid will restrict itself from the very principles it is trying to communicate. Furthermore, while working on innovation projects it will benefit the team to have a broader selection of viewpoints. The importance of diversity among innovation teams is important for successful innovation and for the student to understand. According to Degraff and Degraff, one of the key components of teambuilding for innovation is to ensure that it helps people break from their personal viewpoint; "When it comes to innovation, our dominant worldviews impede creative

[74] Black, *War and Technology*, 53.

thinking."[75] UCCS's model discussed in chapter three of a small innovation core with multiple offshoots covering different disciplines is a perfect example of how to make a curriculum work for a variety of people and situations. Prescribing an exact academic journey for all students may hinder their ability to attack a problem from different angles and result in teams and solutions with too narrow a focus. Enabling them to choose from a wide range of courses and subjects will result in a better end-product.

Second, the coursework should have some process to remain current. As with innovation itself, the tangential components such as technology and methodology, changes quickly. There should be some coursework that involves a look at the current and future landscape of the processes, systems, and technologies that are currently in place. This will help build a foundation for innovation to occur and will give students the ability to make accurate, up to date decisions on how to improve existing structures or develop new ones. Furthermore, the curriculum should have a mechanism to review current course objectives and content and update as necessary. This will prevent stagnation and keep students working where innovation happens, at the border of the present and the future.

Third, the coursework should have enough space to allow students to work on current innovation projects and time to critically think. Filling the entire academic day with coursework would be counterproductive; too much classroom work does not allow for the creativity and productivity necessary for innovation learning. This can be done using dedicated collaborative project work time or "sprint" internships where students can explore areas outside of the normal classroom atmosphere. Most of the current innovation curricula offered at academic institutions build in this type of methodology, providing students with the benefit of utilizing unstructured time.

The classroom instruction is perhaps the most important part of the curriculum; ensuring graduates are armed with the most up to date information and theory regarding innovating in their organizations is clearly necessary. However, while necessary, it is not

[75] Jeff Degraff and Staney Degraff, *The Innovation Code: The Creative Power of Constructive Conflict* (Oakland, CA: Berrett-Koehler Publishers, Inc., 2017), 3.

sufficient to a well-rounded curriculum. There remain two components to generate a successful learning experience that benefits both the students and the DOD.

B. INTERACTION WITH COMMERCIAL INDUSTRY AND THE WIDER DOD ECOSYSTEM

One of the most crucial aspects of an innovation curriculum is its ability to integrate with industry partners and other innovation cells. Nearly all academic institutions that provide education in innovation have some process in place to ensure interaction with industry. Some have physical structures where students, businesses and other organizations can work cohesively and foster "collisions" of ideas and solutions. Others have processes in place like internships and collaborative projects. Either way, they have identified the need for innovators to step out of their environment and solicit ideas from other institutions.

A DOD innovation curriculum should be no different; in fact, it may be even more necessary. People have the perception that defense organizations are separated ideologically from industry; the objectives of national defense and commercial organizations are not often perceived as directly aligned.[76] The resulting effect is a disconnected defense and commercial relationship; "With insufficient access to America's technology hubs, the Pentagon is in danger of ceding its technological edge to our future adversaries."[77] Creating an industry-facing academic program is thus even more vital to bridge this gap. Fortunately, this is becoming part of the DOD strategy; "The Department will also continue to explore streamlined, non-traditional pathways to bring critical skills into service, expanding access to outside expertise, and devising new public-private partnerships to work with small companies, start-ups, and universities."[78] This provides viewpoints on problems from commercial industry, where much of today's innovations are generated.

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[76] Joshua Brustein and Mark Bergen, "Google Wants to Do Business With the Military—Many of Its Employees Don't," Bloomberg, November 21, 2019, https://www.bloomberg.com/features/2019-google-military-contract-dilemma/.

[77] Pablo Carrillo, "Closing the Gap Between the Pentagon and Innovators," *The Hill*, January 27, 2018, https://thehill.com/opinion/national-security/370916-closing-the-gap-between-the-pentagon-and-innovators.

[78] Department of Defense, *Summary of the 2018 National Defense Strategy*, 8.

In the latter part of the 20th century, the DOD largely provided a "pull" from the commercial sector for new technology, most of the money and demand were owned by the DOD. Today, however, that dynamic has changed.[79] In fact, "Through the mid-1980s, the U.S. government accounted for over 50 cents of every R&D dollar spent worldwide. Today, combined federal spending accounts for approximately 10 cents of every dollar."[80] The result is a commercial industry that is largely shifting away from military-only products and building business models aimed at providing new solutions to the civilian customer. This has accelerated the innovation occurring outside the demand of the government. However, these commercial innovations are still required by modern weapons systems and our tactics are still heavily reliant on them.[81] Ensuring the DOD has easy, reliable access to these technologies and the companies that make them will be critical to future innovations in defense. One way to codify this access is to use DOD academic institutions as the conduit for a lasting relationship with the commercial sector.

C. PROJECT-BASED LEARNING FOR INNOVATION

Finally, the curriculum should allow students to "learn by doing" with projects that reinforce academic instruction. Leonard and Swap advocate for what they refer to as "guided problem solving" and "guided experimentation" as the best way to develop people with "deep smarts"—those with good judgment that can "almost intuitively make the right decision, at the right level, with the right the right people."[82] Also known as project-based learning (PBL), this pedagogy aims to bolster learning and has an added benefit of providing useable solutions to real-world problems. PBL is defined as, students learning "through a problem-solving process which includes identifying a problem, developing a plan, testing the plan against reality, and reflecting on the plan while in the process of

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79 Carrillo, "Closing the Gap Between the Pentagon and Innovators."

80 Adam Harrison, "DOD 2.0: High Tech Is Eating the Pentagon," *U.S. Naval Institute Proceedings*, February 2016, https://www.usni.org/magazines/proceedings/2016/february/dod-20-high-tech-eating-pentagon#footnotes; "Science and Engineering Indicators 2014," National Science Foundation, February 2014, https://www.nsf.gov/statistics/seind14/index.cfm/chapter-4/c4s6.htm.

81 Schmidt, Statement of Dr. Eric Schmidt House Armed Services Committee, 2.

82 Dorothy Leonard and Walter Swap, "Deep Smarts," *Harvard Business Review*, September 2004, https://hbr.org/2004/09/deep-smarts.

designing and completing a project."[83] Studies on the efficacy of this pedagogy have ranged through all levels of education. A study conducted on graduate students undertaking courses utilizing a project-based learning methodology found significant improvement in "responsibility, problem-solving, self-direction, communication, and creativity."[84] Furthermore, PBL is effective as "a method of guided discovery learning with the intention of promoting self-regulated deep-level learning".[85] The studies on the effectiveness of PBL have been done across a wide range of disciplines, thus there is no reason to think it will be any less effective for an innovation curriculum. The structure of the PBL method closely parallels many innovation pathways, as innovation, like PBL, is concerned with navigating complex problems and implementing a solution.

Project selection is an important consideration; projects that are closely tied to supporting users' requirements will further amplify learning. Interaction with the problem stakeholders is typically much easier than attempting innovation in a vacuum. Sometimes called "demand-pull" innovations, those which are driven by user demand are typically more rational and better organized than those driven by the innovator."[86] This will allow the student to completely understand the problem and be able to solicit feedback from the user to produce a useful and useable end-result. Rather than coming up with innovation projects on their own, utilizing DOD sponsors with real problems will be more productive. This has benefits to the students as well as the sponsors.

For students, being able to work on a project sponsored by a separate DOD organization will provide benefits from a relationship outside the academic environment. Having a direct demand for innovation helps students understand the importance of identifying the user's problem and seeking to build a solution that will actually work for a

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[83] Scott Wurdinger et al., "A Qualitative Study Using Project-Based Learning in a Mainstream Middle School," *Improving Schools* 10, no. 2 (July 2007): 150,161.

[84] Scott Wurdinger and Mariam Qureshi, "Enhancing College Students' Life Skills through Project Based Learning," *Innovative Higher Education; New York* 40, no. 3 (June 2015): 279, http://dx.doi.org.libproxy.nps.edu/10.1007/s10755-014-9314-3.

[85] Laura Helle, Päivi Tynjälä, and Erkki Olkinuora, "Project-Based Learning in Post-Secondary Education – Theory, Practice and Rubber Sling Shots," *Higher Education* 51, no. 2 (March 2006): 287–314.

[86] Geroski, *The Evolution of New Markets*, 48.

specific organization. Furthermore, analyzing the sponsor organization's characteristics and obstacles enhances learning by giving nuanced situation to deal with and overcome. Finally, sponsored projects have a greater likelihood of success as there is a group that is already seeking a solution and ready to adopt. Non-sponsored projects on the other hand suffer the issue of having to seek out a potential adopter. While there is some benefit to be had from this, most of the innovations that graduates will deal with are not the type where the innovator must seek out an adoption group. These types of innovations are typically accomplished by for-profit businesses seeking to sell a product or process.

The organizations that sponsor project will find obvious value in this structure. By sponsoring a project for student of the curriculum, these organizations will gain increased visibility on a problem they are facing. Additionally, they benefit from the network that the curriculum has, leveraging more resources than they could have on their own. Academic environments have students from multiple backgrounds, with multiple points of view that most organizations don't typically have access to. With a higher probability of success, sponsored projects will more likely result in a solution that users can immediately utilize to increase combat effectiveness.

Establishing the three components to the structure of the curriculum is an important foundation from which to build. Classroom instruction, interaction with external organizations, and project development are the components that will provide the best opportunity to complete the objectives of the curriculum. That leaves one area of consideration left, the content of the classroom instruction.

V. CURRICULAR CONTENT FOR INNOVATION

The content of the academic instruction should aim to produce students that are well-versed in innovation and can utilize their skills, knowledge, and relationships in DOD operational and support organizations. This chapter's purpose is to provide the basis for the academic content through objectives. I am not seeking to define specific classes or courses, as these will vary based on the institution and is not necessary for achieving my goal. Instead, I will offer learning objectives from which administrators can develop a curriculum that results in graduates that meet the needs of the DOD. Depending on the institution, one class may meet several objectives, or several classes may overlap on a single objective. I will establish the objectives through the support of current thinking on innovation as well as empirical examples from other education curricula.

A. INNOVATION FUNDAMENTALS

Objective 1. *Understand essential innovation theory that can be employed in an array of organizations throughout the DOD*. Students should know the process, the key characteristics, and the history of military innovation. As I have done earlier in this paper, defining the context for innovation is an important first step for discussion in the area and is equally as important for students. Students should understand what is meant by innovation and the process by which it evolves. Among other things, this knowledge will help rectify the common misperception that innovation is analogous to technology development. While this is certainly a part of many innovations, new technology on its own does not constitute an innovation. Furthermore, the concepts underlying the innovation process provide a framework that students can apply to myriad situations and organizations, resulting in a more successful innovation system.

As with most academic disciplines, the history and theories of innovation are important to building a foundation for future knowledge. By dissecting case studies such as blitzkrieg, the aircraft carrier, or continuous aim gunfire, students can derive lessons from previous innovations and how to avoid potential pitfalls. Furthermore, knowledge of theories regarding the impetus for innovation, how they are developed and diffused, and

what makes them successful is invaluable to graduates. Three of the most influential theories were derived by Stephen Rosen, Barry Posen, and Dima Adamsky. Rosen argued that innovation is largely a result of top-down pressure; military elites provide the impetus for most radical innovations.[87] Posen on the other hand, argued that most innovations are the result of exogenous forces like civilian intervention to spur innovation.[88] Finally, Adamsky posited that innovation and strategy are strongly influenced by the state culture. For example, America's cultural tendency to "emphasize goals and individual accomplishments rather than the rationale pursued by the group," leads to our relatively high rate of technological innovation but leaves us lagging in long-term strategy innovations.[89] Although this is not an exhaustive list, it offers the epistemic foundation necessary to build graduates well-versed in innovation.

B. INNOVATION ECOSYSTEM

Objective 2. *Have a working knowledge of the DOD innovation ecosystem.* Graduates that will be expected to drive future innovations need to understand who the other players in the arena are, and how to interact with them. This is a constantly evolving area and one that is difficult to conceptualize since organizational objectives are always changing. However, it will be far easier for students to adjust to a changing landscape once they are finished with academics, rather than have to build it from scratch. This knowledge focuses primarily on "innovation cells," as they have been charged with fostering DOD innovation. SOFWERX, AFWERX, Army Futures Command, Air Force Research Laboratory are a few of the key organizations that are pivotal to many innovations in the DOD today. However, there is more to this objective than just knowing the players on the military side; the National Laboratory system and commercial industry play a continual role in current and future innovations.

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87 Stephen Peter Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca: Cornell University Press, 1991), 21.

88 Posen, *The Sources of Military Doctrine*.

89 Dima. Adamsky, *The Culture of Military Innovation; the Impact of Cultural Factors on the Revolution in Military Affairs in Russia, the U.S., and Israel* (Stanford, California: Stanford University Press, 2010), 75.

While it is not the only method, many academic institutions accomplish this objective using "innovation labs" or internships. For example, the University of California Irvine built an off-campus space that "facilitates connections between UCI and industry, including entrepreneurs seeking access to university inventions and talent, large corporations looking to tap the school's research capabilities, and investors wanting to financially support promising new companies."[90] These spaces fulfill the larger objective discussed previously of bridging academia, industry and DOD entities, but also provide a way for students to understand the ecosystem and learn how to work in it.

C. COPING WITH COMPLEX PROBLEMS

Objective 3. *Understand how to identify and dissect problems in a complex and/or uncertain environment.* In the interwar years, France built one of the strongest defensive fortifications in history to that point, the Maginot Line. Utilizing some of the most advanced technology, the Maginot Line was built to withstand almost any enemy attack.[91] Unfortunately, it was a dismal failure. France failed to correctly identify the problem. The German's new tactic blitzkrieg, simply outmaneuvered the line, rendering it ineffective. Had France understood the problem lied in a complex and uncertain environment, rather than the false belief that the environment was simplistic and had remained static in the interwar years, World War II may have gone differently. In essence, "Make sure you are building the right it before you built it right."[92] Working with problems in a complex and uncertain environment is a fundamental step to innovation and one that graduates of the curriculum should be comfortable with.

Many of the military innovations that result in radical change deal with complex problems and are systemic in nature. Little of what we do has a direct, foreseeable solution, nor does it occur in isolation. These "wicked problems" as they are often called are more

90 "UCI Beall Applied Innovation," *UCI - Applied Innovation* (blog), accessed March 4, 2020, http://innovation.uci.edu/about/.

91 Pierce, *Warfighting and Disruptive Technologies: Disguising Innovation*, 26.

92 Alberto Savoia, *Pretotype It*, 2nd ed. (Alberto Savoia, 2011), 7.

difficult to deal with. These problems require more than a linear process, they must be considered differently than "tame" problems. Working without a proper understanding of the problem set presented results in misdirected resources and ineffective solutions that may exacerbate the true underlying problem.[93] Instead, understanding the character of the problem and the environment in which it exists is key, and there are approaches that educational institutions can utilize. Contrary to learning a step-by-step problem-solving process, a more beneficial pedagogy is to teach frameworks that provide guidance but don't necessitate a specific direction. One example of this was created by David Snowden, a framework for dealing with problems called the Cynefin Framework. The framework has two domains, ordered and un-ordered, with four areas, known, knowable, complex, and chaos.[94] The areas in this framework give decision-makers a tool to understand the nature of the problem they are addressing. The theory developed here underpins the idea that one must consider the different environments where problems lie, a cognitive process that a curriculum should and can provide.

D. DIFFUSION AND ADOPTION

Objective 4. *Understand the importance of diffusion and adoption in the innovation process, what the obstacles are, and a potential means to overcome those obstacles.* Many know the German Blitzkrieg strategy as one of the most successful stories of disruptive innovation in military history. The irony is that it was not a German idea, it was first theorized by JFC Fuller, a British officer. His plan, known as Plan 1919, was originally intended to end World War I but never came to fruition because the war ended before it could be implemented. Fuller continued to push for a change to Britain's doctrine of mechanized warfare but could never get it adopted by the organization.[95] The Germans, however, understood the advantage of the theory and adopted it in World War II with

[93] Harold G. Nelson and Erik Stolterman, *The Design Way: Intentional Change in an Unpredictable World*, 2nd ed. (Cambridge, MA: The MIT Press, 2014), 17.

[94] C. F. Kurtz and D. J. Snowden, "The New Dynamics of Strategy: Sense-Making in a Complex and Complicated World," *IBM Systems Journal* 42, no. 3 (2003): 468.

[95] Michael Peck, "5,000 Tanks: The Allies' World War I Plan 1919 Might Have Been the First Blitzkrieg in History," *The National Interest*, October 1, 2016, https://nationalinterest.org/blog/the-buzz/5000-tanks-the-allies-world-war-i-plan-1919-might-have-been-17893.

success. Adoption is perhaps one of the most difficult parts of the innovation process and can often take years to execute.[96] Organizational, procedural, and cultural factors all play a role in presenting obstacles for the adoption of a potential innovation. A recent report by the Secretary of Defense-chartered Defense Innovation Advisory Board noted that adoption was a key weakness of the DOD.[97] While military personnel are generally good at developing new ideas, those ideas often fail to ever see the light.

On the importance of personnel understanding the complex issues surrounding diffusion, Goldman and Eliason state, "The utilization aspect of diffusion—whether and how an innovation is integrated into an acquiring state's organizational structures—is of central importance to contemporary defense practitioners."[98] One way to attack these aspects of diffusion is to break them down into components. Tidd explains that there are "Numerous variables have been identified as affecting the diffusion and adoption of innovations, but these can be grouped into three clusters: characteristics of the innovation itself; characteristics of individual or organizational adopters; and characteristics of the environment."[99] Perhaps one way to increase adoption of new ideas into the DOD organizations is to ensure personnel understand these clusters, what the potential barriers are, and methods to overcome those barriers.

Students considering the characteristics of the innovation should understand how the product they wish to get adopted fits into the perceptions of its potential users. Knowing its strengths and weaknesses within the market, will better enable them to refine and build it to increase successful adoption. Understanding the perceptions surrounding the new product or process and how that will influence adoption is championed by many scholars. Rogers, as well as Tidd, specified several factors that predict the innovation adoption rate:

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96 Rogers, *Diffusion of Innovations*, 1.

97 Defense Innovation Board, "Defense Innovation Board Recommendations," accessed August 29, 2019, https://innovation.defense.gov/Recommendations/.

98 Goldman and Eliason, *The Diffusion of Military Technology and Ideas*, 9.

99 Joe Tidd, *Gaining Momentum: Managing the Diffusion of Innovations* (Singapore: Imperial College Press, 2010), 4, https://ebookcentral.proquest.com/lib/ebook-nps/reader.action?docID=731340.

relative advantage, compatibility, complexity, trialability, and observability.[100] Tidd found that "these five factors explain 49–87% of the variance" in adoption rate.[101] Rouse held a similar theory, advocating that perceptions of viability, acceptability, and validity were key to innovation success.[102] Regardless of the specific categories, students acting as change agents in their future organizations should know how these perceptions influence the rate and likelihood of innovation success.

The product, however, is but one ingredient in the innovation adoption recipe, students also should understand the characteristics of the organization including the cultural components and the obstacles they bring. Innovations often require a substantial change in how people work, and this often provides one of the most formidable obstacles to an innovation.[103] A comprehensive understanding of these obstacles and theories surrounding how to overcome these is a fundamental part of an innovation curriculum. Two of the most known theories came from Horowitz and Jensen. They each developed a theory regarding the makeup of military organizations that make it more likely for those organizations to adopt an innovation. Horowitz argued that the adoption of an innovation is governed by two factors, financial capacity required, and organizational capacity required.[104] Those innovations that require large financial injects of money are less likely to be adopted simply because they drive up the risk vs reward equation. Attributing large quantities of money to a new product or process is difficult for organizations to justify to higher headquarters or congress. Thus, they are less likely to be approved and implemented. The other factor, organizational capacity, functions similarly. Those innovations that require the organization to change beyond what it is comfortable undertaking, risk failing to gain adoption.

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[100] Tidd, 20; Rogers, *Diffusion of Innovations*, 221.

[101] Tidd, *Gaining Momentum: Managing the Diffusion of Innovations*, 20.

[102] Rouse, *Catalysts for Change: Concepts and Principles for Enabling Innovation*, 5.

[103] Mark. Stefik and Barbara Stefik, *Breakthrough!: Stories and Strategies of Radical Innovation* (Cambridge, MA: MIT Press, 2004), 182.

[104] Horowitz, *The Diffusion of Military Power Causes and Consequences for International Politics*.

Jensen, on the other hand, argues that the two factors determining adoption are incubators and advocacy networks.[105] Incubators offer a space "free from the normal push and pull of the bureaucratic hierarchy in which professional military officers are free to visualize new theories of victory."[106] The innovations that have been successfully adopted are those which were developed from incubators, without which people are not able to see outside their rigid military structure. The next element, advocacy networks, are equally as important. They serve the function of circulating and legitimating the innovation.[107] These networks serve as change agents and are required to promote innovations through the organization. Students of innovation seeking to understand the organizational obstacles to innovation can begin here with analysis of their organizations and how well they are set up for innovativeness, this is an essential piece of knowledge and a worthy curriculum objective.

E. DESIGN THINKING

Objective 5. *Understand the importance of design thinking, know how to integrate it into the innovation process, and apply it to a real-world problem*. On March 3rd, 2020, Chief of Staff David Goldfein gave a brief to congress regarding the Air Force's newest aircraft, the KC-46 Pegasus. Congressional members were concerned about budgetary issues and defense readiness. In his comments, General Goldfein told Congress that the Air Force would not be using the KC-46 in the near future except in the case of a "high-end contingency."[108] After years of delays, the KC-46 has run into several major issues. It was not capable of safely executing its two primary missions, carrying cargo and passengers, and aerial refueling. This was due, among other things, to several design flaws. The floor cargo locks have come loose during flight, the boom camera appears warped to boom operators causing boom contact with receivers, and the system can't properly refuel the A-

105 Benjamin M. Jensen, *Forging the Sword: Doctrinal Change in the U.S. Army* (Stanford, California: Stanford University Press, 2016), 17.

106 Jensen, 18.

107 Jensen, 19.

108 Rachel Cohen, "Goldfein: USAF Won't Use KC-46 Unless It Has To," *Air Force Magazine*, March 3, 2020, https://www.airforcemag.com/goldfein-usaf-wont-use-kc-46-unless-it-has-to/.

10.[109] A brand new plane that the military cannot use because of poor design. The errors associated with this project reinforce the importance of design to innovation; if a product or process is not properly designed for the user, it will face an uphill battle in becoming a success.

Design thinking and successful innovation are closely related and follow similar paradigms. Sometimes misunderstood, design is more than just making things look good, it is making them functional and useful.[110] It is coming up with new ideas, exploring different possibilities to develop a solution that fits into its environment.[111] One must carefully consider what the client needs and design a product or process to fit those needs and ensure it works for the client; in essence, "live the customer's experience."[112] Design thinking requires one to "gain both objective and subjective understanding on behalf of another's interests rather than in one's self-interest only."[113] A true understanding of the client's interests and the environment is the only way to design a product or process that will result in successful innovation. Dorst uses the term "frame innovation" to convey this idea. He says it is more than just coming up with solutions, innovators need to "create more approaches to problem situations."[114] Applying this to a military context, design is concerned with how well a weapon or process fits the interests of the fighting force and its strategy; the design of troops and weapons needs to be aligned with strategy.[115] The importance of creating a method to incorporate this idea into our innovation strategy cannot be understated: "Organizations which successfully use design to achieve their ends create

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109 Valerie Insinna, "Us Air Force Restricts KC-46 from Carrying Cargo and Passengers," *Defense News*, September 11, 2019, https://www.defensenews.com/breaking-news/2019/09/11/air-force-restricts-kc-46-from-carrying-cargo-and-personnel/.

110 Kees Dorst, *Frame Innovation: Create New Thinking by Design* (Cambridge, MA: The MIT Press, 2015).

111 Brown, *Change By Design*.

112 Jeanne Liedtka, "Why Design Thinking Works," *Harvard Business Review*, 2018, 76, http://search.proquest.com/docview/2112205981/.

113 Nelson and Stolterman, *The Design Way*, 46.

114 Dorst, *Frame Innovation*, 2.

115 John Arquilla and Nancy Roberts, *Design of Warfare* (Monterey, CA: Naval Postgraduate School 2017), 63.

a stronger adaptive fit to the world around them."[116] So how can we ensure innovators are designing for success? I believe it starts with education.

Design thinking is vital to innovation success; however, one cannot hope to rely solely on instinct and intuition, education is paramount. "Becoming a designer is not something one does on one's own. It is in most cases a process that you engage in as a student in a more formal education process, in addition to any informal learning that may be taken advantage of."[117] In defense of a broad-based education to support professionals endeavoring to bring design into their organizations, Ken Friedman explains "If designers are to approach their work as a design science, they require the background that permits them to understand complexity. This means a broad education based on problem-solving and pattern building rather than a narrow education based on repetition, exercise and imitative patterning."[118] Education dedicated to the development of design *skills* should be at the heart of any innovation curriculum.

116 Ken Friedman, "Design Science and Design Education," in *The Challenge of Complexity*, ed. Peter McGrory (Helsinki: University of Art and Design Helsinki UIAH, 1997), 54–72.

117 Nelson and Stolterman, *The Design Way*, 234.

118 Friedman, "Design Science and Design Education."

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VI. CONCLUSION

A. CURRICULUM DEVELOPMENT

The American military is known for its personnel with a "can do" mentality; we find a way to overcome when others see none. History—both military and national—is rife with facts and stories where innovation allowed us to adapt, overcome, and prosper. Strategic aerial refueling, nuclear submarines, and Special Operations Command to name a few. Americans are known for doing things that have never been done before or doing things in ways—creating approaches and processes—that are new and useful and, in many cases, revolutionary. In those instances, Americans are considered innovators and early adaptors. Recently, however, our military is losing its innovative edge over adversaries and has fallen behind the commercial industry in its ability to generate and implement new ideas. Our processes have become stagnant, our incentive structure washes out risk-takers, and our product research and development relies on Cold War-era paradigms. In an age where our adversaries are rapidly gaining strength, we need to reimagine how we think about innovation and give our personnel the means to execute. Education and a curriculum specifically designed to teach innovation to our personnel is an integral part of this effort.

The basis of the argument stems from a cognitive model that has shifted in the last several decades. Previous DOD innovation efforts largely came from large defense contractors, private thinktanks, and public universities. However, today's environment is much different. Tech giants and commercial industry startups, beholden to a market increasingly devoid of DOD influence, have quickly become the leaders in the development of the most advanced technology and innovative breakthroughs. No longer can the DOD rely on the luxury of technology and innovative ideas coming to us, we must seek them out in their commercial form and adapt them to our needs. Fortunately, there has been some movement in the last several years to break the stagnation in innovation and design new ways to bring innovation to the force. Organizations like DIU and AFWERKS are leading the charge to change our patterns and hopefully change our culture of innovation. However, there still exists a gap in fully realizing these changes and producing a long-term solution; we are not equipping our personnel with the knowledge and skills

required of this shift in innovation strategy. Education needs to be at the forefront of this effort, and a curriculum designed specifically to teach innovation can be extremely influential.

To design the structure and content of this curriculum, we first must look at what exactly we mean by innovation and what are some of the foundational tenants. In current literature, there are several components of innovation that are essential for developing a foundation from which to build. Innovation can be defined as *the process by which a new and improved practice is developed and adopted by a group.* This definition considers several components drawn from innovation theories in the commercial and military sectors. First, innovation is a process. One cannot expect to come up with an idea and have it immediately absorbed into an organization and implemented as current practice. There are many steps and overlapping issues that must be dealt with, support that needs to be garnered, perceptions changed, and obstacles overcome. This is not to say there is an exact recipe for success, in fact most attempted innovations result in failure. However, innovators still must operate with the notion that they are not simply inventing an item, innovation requires much more. Second, innovation entails developing a practice that is new and improves upon the previous practice in place. A key word here is practice, which reinforces the idea that innovation is not solely concerned with new technology; improving the underlying practice is of chief concern. Take for example a drone, an autonomous flying machine is an invention, but once we use it to change the way we execute surveillance, it becomes an innovation. Finally, an innovation needs to be adopted by a group. This dovetails into the previous argument surrounding invention vs innovation. To see a truly successful innovation, we need to see it implemented and used across an organization. Understanding what is meant by innovation is but one part to develop education surrounding it, the other part comes from existing examples.

Most of the examples of innovation curricula come from non-military educational institutions and organizations. There are several different programs available and they cover a wide range of pedagogy. The programs generally fall into three categories. First, there are programs designed to specifically teach innovation. Second, there are those that seek to build a physical space for students, government entities, and businesses to

collaborate and coalesce on innovative ideas. While these programs provide much of the structure necessary for developing and implementing innovations, they are providing little instruction on how to make the innovation successful. Finally, there are programs that provide students with an "executive" course designed for immediate implementation into their current jobs. These programs are shorter and less comprehensive but provide the basis for innovation thinking. While each of these program types can add value for the DOD, a curriculum designed specifically to teach innovation is perhaps the most useful and should be the we pursue to begin.

Based on these examples from other academic institutions as well as innovation principles, we can determine the best structure and content for a military curriculum. The curriculum should have three overlap elements in to be effective and achieve the objectives of teaching innovation, bridging gaps in the current DOD innovation ecosystem, and providing the DOD with immediate return on investment of ready-to-use innovative products and processes. First, the curriculum pedagogy should be project-based learning. Incorporating a real-world project into the learning environment will help student learn and understand the principles involved, allow atypical approaches and failure in a low-risk environment, and potentially provide an end-product for users. Second, the curriculum should be structured in a way that allows for outside collaboration. Working with other organizations from the public and private sector is fundamental for today's innovation and builds the relationships outside the military that the DOD needs. Third, the curriculum should have an instructional component to provide students the necessary knowledge and skills to carry on to future organizations and instill a culture of innovation in the DOD.

Finally, the content of the curriculum is designed to fit into the structure described above and produce graduates that are well-versed in a broad spectrum of innovation. Creating a curriculum that is too focused on one part of innovation, like technology, will not provide the depth needed for the wide range of innovation that the DOD needs. Students should have a basic understanding of the fundamentals of innovation. Understanding of the processes and theories surrounding innovation from both a commercial and military perspective are a foundational building block. Students should understand the current innovation ecosystem; working with external organizations is paramount for successful

development of today's nascent innovations. Students should comprehend the meaning of problems identification and how to deal with them in a complex environment. Proper consideration of how military problems function in complex systems is the only way to have replicable success in innovation. Next, students should understand and demonstrate they have the requisite knowledge concerning innovation diffusion and adoption. This step is rife with obstacles and a primary point of failure for innovation. As such, it is one of the most important parts of the innovation process to understand and be able to navigate. Finally, design thinking permeates almost every part of innovation and is an essential. Students that design with the problem, the solution, and the user in mind will ultimately yield the best results. These objectives are rooted in innovation principles and empirical evidence and have definitive concepts that a curriculum can provide.

B. THE WAY AHEAD

While I have identified some of the primary steps in building an innovation curriculum, there remains some important work left to make it successful. The goal for administrators of the curriculum should be to allow access to the entire DOD. This will require different delivery methods, both in person and in correspondence. We cannot hope to send everyone to a residence program so distance learning by some means will be important. Work still lies with how to incorporate both in residence and distance learning into a cohesive program. The most benefit will come with a collaborative program where students from around the force can join with students in residence to learn innovation while working on something currently plaguing their organization. This gives commanders an incentive to promote the program and the cross-organizational elements that build a cohesive innovation ecosystem.

Perhaps the best location for the curriculum resides in our established professional military education institutions. Our military education institutions have been the bedrock for officer education for decades, providing influential benefit early in the century, during the interwar years and beyond.[119] Recently however, they have come under fire for being

[119] Peter J. Schifferle, *America's School for War: Fort Leavenworth, Officer Education, and Victory in World War II*, Modern War Studies (Lawrence, Kansas: University Press of Kansas, 2010).

"stagnate" and not producing the type of officers the military needs.[120] Along with the criticisms comes an equal number of differing proposals on how to make them better. One thing most agree on however is, "The professional military education system is sitting on a gold mine of talent and intellectual prowess."[121] One immediate way to increase benefit from our education institutions while utilizing the talent and ideas of the officers attending the institutions is to provide a more diverse learning experience. In addition to core operational literacy, the institutions have the leeway to allow personnel to build competencies in other areas.[122] Bringing an innovation curriculum to the institutions will refresh and amplify our education, focus on needed objectives, and increase the institution's impact.

Our military education institutions are ideal places for an innovation curriculum because they provide a "safe space" for officers to utilize innovation concepts and offer access to networks. Networks are an important part of innovation as they provide an "ecosystem" that fosters diverse thought and angles to attack a problem. Furthermore, these "advocacy networks represent cross-cutting institutional networks that spread the ideas throughout the broader defense community."[123] DOD educational institutions are a prime location to build these networks as they have access to operational personnel from multiple organizations, academia, and are generally more "outward-facing" than typical military units.

Additionally, the military education institutions provide a space outside of operational units for personnel to freely think and reflect on problems and investigate possible solutions. The necessity of these "safe spaces" is advocated for in both commercial and military thinking. Spin-off organizations separated from the main body are often the

120 Paula Thornhill, "To Produce Strategists, Focus on Staffing Senior Leaders," War on the Rocks, July 20, 2018, https://warontherocks.com/2018/07/to-produce-strategists-focus-on-staffing-senior-leaders/; Department of Defense, *Summary of the 2018 National Defense Strategy*.

121 Austin Duncan and Adam Yang, "Exploiting the Wellspring: Professional Military Education and Grassroots Innovation," *War on the Rocks*, July 19, 2018, https://warontherocks.com/2018/07/exploiting-the-wellspring-professional-military-education-and-grassroots-innovation/.

122 Duncan and Yang.

123 Jensen, *Forging the Sword: Doctrinal Change in the U.S. Army*, 2.

best locations from which to develop disruptive innovations. They allow focus on the development of innovations while the main body can retain resources on the sustaining operations necessary to keep the organization afloat.[124] These spin-off organizations, or "incubators," are one of the necessary components of innovation "Innovation requires new forums or subunits free from the normal push and pull of the bureaucratic hierarchy in which professional military officers are free to visualize new theories of victory."[125] DOD academic institutions are the perfect place from which to build an innovation framework because they provide a spin-off organization that has access to networks.

Another issue that needs to be addressed is how to select projects for students to work on and learn from. Administrators should have a set of criteria to select projects that strike a balance between achieving learning objectives and providing an immediate solution to the DOD. Characteristics like project complexity, duration, usefulness, obstacles, and sponsorship should all be considered when determining which projects students should work on. It is important to not get too wrapped up in chasing the next gadget, we are trying to teach students, not make widgets. Ultimately, it is important to remember that the greatest long-term return from the curriculum will be graduates that can take new skills and outlooks to their organizational and continue to foster innovation on a continual basis.

The culture of innovation in our military and the DOD at large needs a paradigm shift. We cannot rely on commercial industry to innovate for us; their incentives lie with the general population; military applications have become just a small subset of their business. Because of this we must take innovation into our hands. The paradigm of doing things because "that is how they have always been done" needs to end; we need to empower our personnel to develop their own ideas of how to do things better and provide them with the tools and space to do so. The first step in this endeavor is education; a curriculum designed to teach and foster innovation will have lasting effects and carry our force into the future.

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[124] Christensen, *The Innovator's Dilemma*, 176.

[125] Jensen, *Forging the Sword: Doctrinal Change in the U.S. Army*, 18.

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