Military history provides numerous instances of states failing to recognize the implications of disruptive innovations. Contentment with incremental improvements on existing capabilities, such as weapon hand grips, autonomous capabilities, and augmented reality during operations, will not be enough to ensure the overall superiority of SOF warfighters. The impact of today's decisions will compound as the pace of technological change accelerates. Failure to effectively harness disruptive innovations today reduces future decision options, operational capability, and the likelihood of winning tomorrow's fight.

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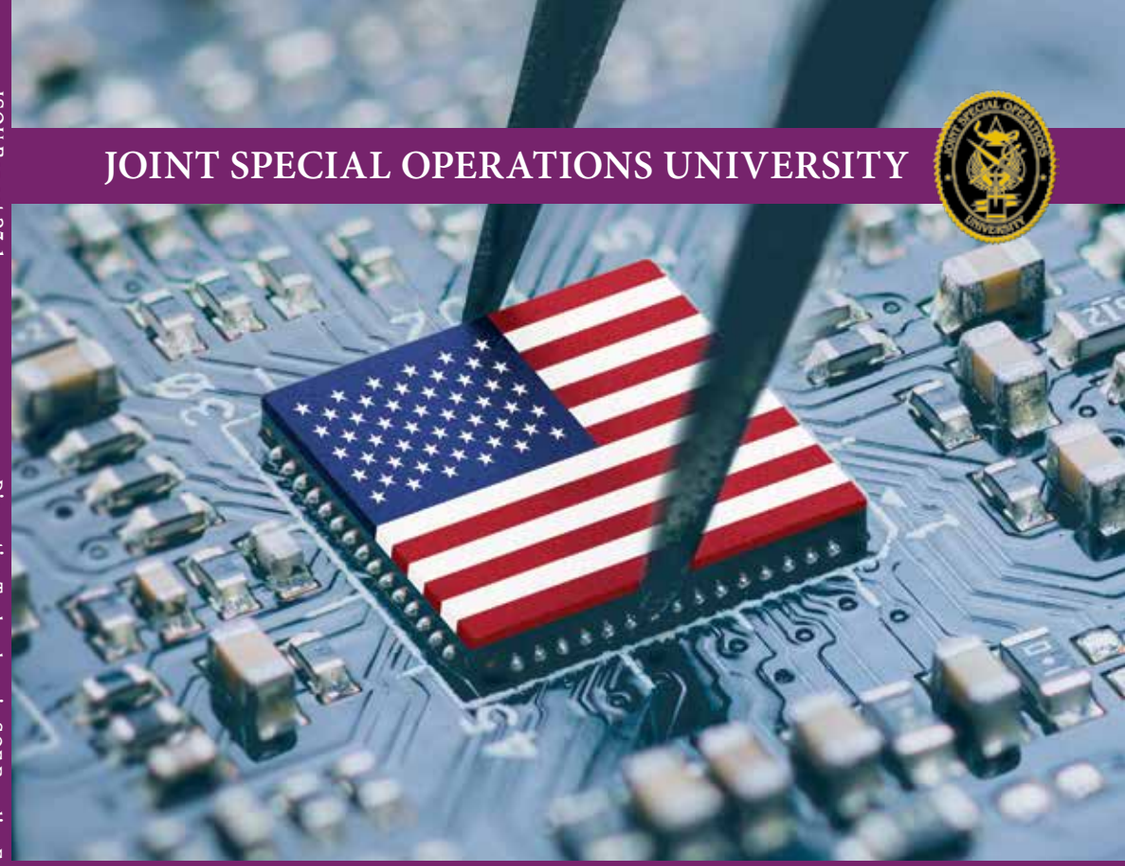

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Disruptive Technology in SOF-Peculiar Environments: Promises and Challenges in Development, Management, and Acquisition and Procurement

Dr. Benjamin Tkach

JSOU Report 23-1

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Disruptive Technology in SOF-Peculiar Environments: Promises and Challenges in Development, Management, and Acquisition and Procurement

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Introduction

How does United States Special Operations Command (USSOCOM) build competitive advantages to optimize disruptive innovations for future operating environments (FOEs)? This multifaceted research question requires investigation of Special Operations Forces (SOF) acquisition and procurement processes to address today's decisions that shape tomorrow's FOEs. Consistent with U.S. national security policy and military reorientation,[1] SOF FOE will be characterized by peer, near-peer, and nonstate actor competitors that leverage advanced technological capabilities to affect battlespaces and societies to disrupt U.S. activities. Development of competitive advantages and achieving overmatch technologies across the spectrum of SOF's operational responsibilities require evaluation of disruptive innovations within the context of their SOF-peculiar application. This holistic approach aims to identify technical, policy, and acquisition hurdles involved with the development and fielding of disruptive innovations.[2] Technologically disruptive innovations are rapidly advancing in the private sector, Department of Defense (DOD), and potential adversaries at a time when U.S. fiscal concerns are mounting, defense budgets are inconsistent, and national artificial intelligence (AI) policy is still forming.[3] In this changing environment, USSOCOM faces challenges to continue to win today's fight while planning for tomorrow's advancing technology, tight fiscal environment, evolving adversaries, and its own bureaucracy. Harnessing disruptive innovations better than adversaries requires review of existing processes, recognition of limitations, and policy adaptation. USSOCOM excels at adaptation and can win tomorrow's fight with deliberate action today.

Disruption is more than incremental change. Disruption requires reconceptualization of the original function. When applied to military contexts, disruption is the integration of technology, policy, and strategy that redefines operational activities. Disruptive innovation is the culmination, convergence, and leveraging of three distinct areas.[4]

First, disruptive innovations emerge when there is political will to implement national (or corporate) strategies that reconceptualize activities and develop capabilities to deliver them. For USSOCOM, political will is acceptance by command leadership that disruptive technology may impact

the manner in which SOF contribute to strategic, operational, and tactical assumptions, policies, procedures, and decision making. Second, disruptive innovation occurs when new technology to implement an innovation is economically feasible.[5] For USSOCOM, economic feasibility is more than simply price; feasibility means that the innovation can be identified, acquired, procured, and fielded while retaining its disruptive capacity.[6] Third, disruptive innovations emerge when policies (i.e., management, testing, fielding acquisition, procurement, operations, etc.) are tailored to utilize the innovation. For USSOCOM, policy cohesion—from warfighter needs to capability delivery—is synchronized such that the nature of warfighting, operations, and/or capabilities will be changed by the disruptive innovation, and metrics will need to be developed to capture its effects. Failure to act in any of these three areas will result in settling for incremental improvements of existing capabilities instead of the revolutionary change generated by disruptive innovations.

USSOCOM is positioned to benefit from emerging innovative ecosystems because of its political will to pursue change and comparatively streamlined policy processes. USSOCOM is the DOD's leader in the acquisition of specifically tailored solutions to warfighter problems.[7] Pursuit of disruptive innovation through alignment of political will, economic feasibility, and policy cohesion is necessary at the command level as leadership determines priorities and engages with major stakeholders (e.g., Congress and the Services). Alignment of the three factors also occurs at smaller scales, such as through integrated product teams or individual acquisition groups within the Program Executive Office (PEO). Special Operations Forces Acquisition, Technology, and Logistics/Contracting (SOF AT&L-K) consistently improves capabilities in support of the warfighter across the research and development (R&D), procurement, deployment, and sustainment life cycle. The importance of these incremental improvements cannot be overstated. They have resulted in the majority of SOF AT&L-K's organizational focus and effort being correctly and effectively apportioned to achieve SOF objectives.

That being said, new challenges are evident with regard to the work of identifying and leveraging disruptive innovations. This work involves peculiar pressures, constraints, and hurdles. An examination of these features—and how they can be addressed—is the focus of this publication. Specifically, this monograph examines how identification of disruptive innovations occurs and how organizational changes can facilitate the development and

acquisition of such innovations. Of particular interest are disruptive innovations in areas where current capabilities do not yet exist and are unlikely to emerge without the direct, deliberate involvement of the SOF community.

The example of the Tactical Assault Light Operator Suit (TALOS) illuminates the dynamics between pursuit of disruptive innovation and incremental improvement. The aspirational goal of TALOS was to produce a fully functional suit that protects the first-through-the-door warfighter (a new capability comparatively less needed by the Services than by SOF). A review of the TALOS program indicates that, even at the earliest stage of program initiation, incremental improvements (not a fully functional suit) were the goal of the program and the metric used for program evaluation.[8] The emergence of disruptive innovation, however, requires a willingness to pursue audacious goals where the likelihood of success is low and failures may occur.[9] TALOS highlights the difficulty of pursuing disruptive innovation in an environment where supporting the current force with incremental improvements is the highest demand. The combination of political will and streamlined acquisition and procurement policies enabled investment in TALOS without sacrificing sustainment of the Force and investments in other areas.[10]

However, the limited size and scale of USSOCOM's budget means that it will continue collaborative efforts with industry, academia, and the DOD for R&D—a practice consistent with the existing acquisition model. While this approach facilitates comparatively effective traditional procurement, it may not yield disruptive innovation in FOE because disruptive innovation requires tailoring solutions to specific SOF challenges. SOF application of disruptive innovations faces distinct challenges because of a unique operational environment that generates less data than commercial or service operations as well as the constant necessity for operational flexibility and adaptation. For example, when applying artificial intelligence (AI) and machine learning (ML) to supply chains, SOF will benefit from predictive analytics from commercial or Service applications because the underlying training datasets are similar. Application of ML to more sensitive areas such as operations or unit deployments may be less effective as the underlying data (e.g., operational tactics) is distinct from the Services.

Military history provides numerous instances of states failing to recognize the implications of disruptive innovations.[11] For USSOCOM, broad and varied expectations of FOE are necessary to ensure that today's decisions

set the stage for future policies that are conducive to disruptive innovation generation and incorporation. Contentment with incremental improvements on existing capabilities, such as weapon hand grips, autonomous capabilities, and augmented reality during operations, will not be enough to ensure the overall superiority of SOF warfighters. Further, the perceived operating environment over the next thirteen years (FOE 2035) features a changing landscape—rising peers and near peers who are simultaneously pursuing disruptive innovation but without the same legal framework and bureaucratic constraints; non-state actors whose technological savvy has already frustrated operations; and policy makers' increased utilization of SOF.[12] These elements will place additional burdens on the Force. The impact of today's decisions will compound as the pace of technological change accelerates. Failure to effectively harness disruptive innovations today reduces future decision options, operational capability, and the likelihood of winning tomorrow's fight.

Monograph Outline

This monograph is divided into three chapters. Chapter 1 establishes a framework to analyze disruptive innovation by assessing how political will, economic factors, and policies are necessary to harness innovations. Chapter 2 examines USSOCOM's acquisition and procurement practices as well as its adaptability to disruptive innovation. Chapter 3 provides case studies of potential disruptive innovations in areas of social manipulation and AI/ML in the FOE 2035. The monograph concludes with a set of policy recommendations. Following is a contextualization the monograph's argument by examining disruptive technology in the context of SOF's competitive advantages, existing acquisition processes, and societal manipulation through misinformation.

Adaptation, Disruptive Technology, and SOF's Competitive Advantages
Chapter 1 presents a framework to assess the interaction of information and data technologies, organizational adaptation, and managerial policies necessary to field tomorrow's disruptive technologies. USSOCOM is the DOD's leader in adaptability, innovation, and experimentation. Integration of disruptive technologies and contributions to the hyper-enabled operator (HEO) concept will necessitate policy and acquisition coordination. USSOCOM's successful integration of disruptive technologies will require targeted R&D

activities as well as extensive collaboration with the DOD, industry leaders, and academics because the financial intensity and testing capabilities necessary for development are typically beyond existing budgetary boundaries, recruitment practices, or personnel availability.

Next is the analysis of impediments to interoperability, which is essential to multi-domain operations. Impediments are analyzed in relation to a template that can be used to evaluate organizational adoption of innovation.[13] Impediments are discussed in relation to the perspective of private-sector industry as well as USSOCOM at a time when the command seeks to pursue open-architecture solutions and accelerated acquisition in a constantly evolving data space. Finally, the assumption that industry and academia will perpetually partner with and facilitate military applications of technology is examined. Silicon Valley's recent reticence regarding the militarization of digital services (e.g., Google backing out of Project Maven) suggests that, going forward, multilevel U.S. collaboration around disruptive innovations faces challenges.

Existing Acquisition Processes

Chapter 2 evaluates existing acquisition processes and doctrines to identify policy adaptations necessary for disruptive innovation. Disruptive technologies require adaptation of acquisition processes at multiple points from requirement verification to sustainment. Various aspects of the acquisition process are investigated, such as comparative source selection authority levels, funding stream dynamics, requirement verification processes, and design/adaptation opportunities, to identify best practices in procurement of revolutionary technology.[14] How technology readiness levels (TRLs) and manufacturing readiness levels affect deployment of disruptive technologies is also examined. Finally, this section investigates SOF-peculiar challenges that require balancing multiple factors including acquisition speed, price, data rights ownership dynamics, warfighter needs, and economies of scale.

Retaining a competitive edge is contextualized in this section with an emphasis on procurement. Because successful fielding of a disruptive innovation involves command-wide engagement with all stages of the acquisition process—from the planning stage, to requirement verifications, to acquisition and procurement—disruptive innovation and integration accelerate in networked contexts. Although, public-sector procurement may be slowed (compared to private-sector procurement) because of regulations

and policies.[15] Consistent with the Services, USSOCOM operates under Federal Acquisition Regulation (FAR) rules, which can impede private-sector engagement. Procurement, which occurs toward the end of the acquisition process, faces particular restrictions unique to government contracting. Yet, procurement processes are fundamental to fielding disruptive innovations, and they serve as a barometer of past reform policy efforts and existing efforts given constraints within the bureaucratic system.

The reality is that ensuring a competitive advantage for SOF requires innovative acquisition policies. Adversaries who are either near-peer or non-state actors are not bound by rigorous federal acquisition requirements. From one perspective, the lack of legal and ethical constraints on adversaries is an organizational disadvantage for USSOCOM.[16] At the same time, well-run bureaucracies may contribute to victory in power competitions with autocracies over the long run. This section examines USSOCOM procurement procedures, outcomes (e.g., duration of negotiation, protests, etc.), and personnel throughout the organization to investigate how organizational structure, organizational culture, and personnel staffing processes affect efficacy. USSOCOM is then compared to other DOD organizations, the federal government, and the private sector to identify best practices in organizational and personnel policies. This section identifies concrete changes USSOCOM can implement to ensure a competitive advantage, lead DOD efforts, and win the fight of the future.

Disruptive Technology and Social Manipulation

Chapter 3 examines disruptive technologies in one specific USSOCOM priority area—where nascent technology is rapidly evolving in the private sector, experience in acquisition is limited, and near-peer competitors are developing capabilities.

With regard to propaganda, for example, the use of disruptive technologies to manipulate individuals, societies, and politics is analyzed. The dissemination of propaganda through social media by state and non-state actors and its influence on active conflicts and grey zone operations is now well documented. Current USSOCOM acquisition executive, Jim Smith, recently stated that "the ability to tell our message in clear text to a population … is a core competency for us."[17] As adversaries increasingly develop social media capabilities and, in some cases, directly deploy them against the U.S., increased reliance on social media for news, updates, interactions, and

communication places a security imperative on USSOCOM to understand and address online propaganda.[18] In this monograph, existing evaluations of open-source intelligence are extended by forecasting the technologies necessary to collect, analyze, and implement next-generation messaging in terms of profiling algorithms, cloning software, hacking tools, and other innovations in a SOF context. A specific analysis of the potential utility of disruptive technologies is then provided to identify how receptive an individual or society (sub-group) is to propaganda and messaging based on Thoroughgood's taxonomy of five types of followers.[19] Identification of follower types has direct mission applications in terms of identifying individuals susceptible to different political allegiances, assessing individuals' willingness to share intelligence, and evaluating other operational factors. The monograph then analyzes the potential of disruptive technology to incorporate and address highly tailored sociocultural adaptations necessary for social media and open-source intelligence to be operationally and strategically beneficial.

Methods

Qualitative methods are applied in each section to maximize insights from available unclassified sources. Qualitative methods are used to evaluate specific policies, rules, and procedures within SOF AT&L-K. Face-to-face interviews were conducted in the summer of 2019 with SOF AT&L-K contracting personnel at MacDill Air Force Base. Phone interviews were also conducted with Theatre Special Operations Command (TSOC) contract officers (KOs). The interviews were conducted using a semi-structured interview guide and analyzed with ethnographic techniques. Semi-structured interviews minimize interviewer effects while ethnographic methods allow interviewees to identify key concepts and establish the interaction amongst those concepts. The combination of qualitative methods and interviewees from different positions within the organization generates a cross-cutting evaluative approach that distills responses into organizable components of information. Interviews focused on current acquisition and procurement policies and processes, and analysis of interview responses provides insights into future policy opportunities and hurdles.

Chapter 1. Disruptive Technology and SOF

This chapter provides a theoretical framework for understanding how competitive advantage can be gained and maintained through disruptive innovation. In the first section, SOF-relevant definitions of key terms, which are frequently reduced to mere jargon when adopted outside of their original context or haphazardly used, are clarified. With terms clarified, the chapter turns to an examination of competitive advantage and disruptive technology in the SOF context. In the following section, potential characteristics of FOE 2035 are contextualized by drawing on military expectations. Specifically, this section examines potential capability changes that affect multi-domain battlespaces and aspects of societies in which SOF operate. Finally, the concluding section analyzes the DOD's plan to acquire and procure disruptive innovations, which conditions USSOCOM approaches.

Competitive Advantage

Why conceptualize and define terms that are commonly used in military and civilian contexts? Academic terms often devolve into jargon that is frequently cited but rarely understood or correctly employed to achieve clear understanding. The potential danger to USSOCOM, the DOD, and the federal government more broadly is that failure to recognize and utilize terms consistently impacts policy decisions that ripple into the future. For USSOCOM, the terms "competitive advantage" and "disruptive technology" must be fitted to SOF-peculiar contexts. Buzzwords, acronyms, and catch phrases proliferate around the concept of innovation among acquisition and procurement professionals. Nevertheless, definitions and even technologies may not be clearly or fully understood.[20] Limitations in conceptual framing have potential negative, long-term effects on policies and military capabilities. A conceptually restrictive understanding of "disruption," for example, may contribute to USSOCOM settling for technological, policy, and operational improvements that are merely evolutionary, while adversaries pursue revolutionary change. Conversely, a correct understanding of disruptive innovation can contribute to the prioritization of risk acceptance

and capability delivery in the acquisition process. The following section reviews DOD criteria for identifying competitive advantage and disruptive technologies (innovation), draws inferences from past military innovations, and evaluates the consequences of misconceptualizing disruption for military and industry collaboration.

Competitive advantage is the translation of technological innovation, economic capability, public policy, and military doctrines to achieve military objectives. For decades, the U.S. military has enjoyed unparalleled competitive advantages over adversaries.[21] The end of the Cold War ushered in a period of unrivalled force projection capability and U.S. military dominance. Indeed, this combination of force projection and military dominance was unrivalled to such a degree that it gave rise to the notion of omnipresence—the idea that U.S. Forces could confront and defeat any adversary at the time and place of its choosing.[22] Continuation of this competitive advantage is central to the Third Offset doctrine, which focuses on technology development to prevent conflict with a great power but to win if a conflict arises.[23] Yet, U.S. competitive advantage is eroding.[24]

Challenges to U.S. competitive advantage take several forms along two dimensions. The first of these pertains to the U.S. domestic environment, which conditions competitive advantage through research, development, and accessibility of technological innovation. At the macro level, U.S. R&D spending as a percentage of global R&D and federally funded research as a percentage of gross domestic product continue to decline.[25] These declines threaten U.S. platform supremacy (e.g., leading technology sectors such as AI, synthetic biology, advanced manufacturing, etc.),[26] which affects DOD and USSOCOM access to technological supremacy. In the absence of coordinated national polices, the period of perpetual U.S. technological advantage over peers is now over.

The U.S. federal budget process constitutes a hurdle for disruptive innovation at the micro level. The existing budget process does not allow for unobligated fund requests to be built into future annual budgets, meaning that pursuit of disruptive innovations is difficult to build into the budgeting process. The limitations of federal budget planning flexibility constrain opportunities for disruptive innovations at the micro level as managers and teams must creatively solve budget restrictions. DOD Directive 5000.01 instructs program managers to accelerate the acquisition process. Inconsistent budgets, such as continuing resolutions and sequestration, enact

budgetary actions that disrupt research, prototyping, development, acquisition, and procurement and thereby threaten future military capability. For existing military capabilities (i.e., personnel, platforms, and technology), continued funding through regular and consistent federal budgets is essential for retaining competitive advantages.[27]

U.S. competitive advantages are also conditioned by the international environment. Strategic rivals, specifically China and Russia, identified as such in the 2018 U.S. national security strategy, represent different challenges than post-Cold War military interventions that sought to transform political and economic systems in areas where American interests were not present.[28] Peer and near-peer adversaries are more capable of producing contested battlespace across different domains compared to counterinsurgency (COIN) efforts of the past decade.[29] Additionally, the emergence of gray zones (areas of conflict that are below major wars but where war may escalate) further challenge U.S. omnipresence as adversaries increasingly pursue anti-access, area-denial strategies. Russia's application of economic tools to extract concessions and its limited use of security forces (i.e., Syria), as well as China's militarization of the South China Sea, challenge the U.S. pursuit of omnipresence. International challenges directly affect SOF's competitive advantages, even as USSOCOM itself constitutes a competitive advantage in near-peer competition for the Joint Force.[30]

SOF's competitive advantage is based on persistent engagement, enabling partners, and discreet action.[31] In each area, USSOCOM's ability to conduct a wide variety of operations as "generalized specialists" and internal policy promotion of capability has elevated SOF's role in U.S. policy over the last two decades.[32] The comparative advantage of highly capable small units in combined action is well established.[33] SOF's comparative advantage in support of indigenous forces remains unmatched, though the demand in gray-zone conflicts has, at times, outstripped USSOCOM's ability to provide support. This has resulted in ad hoc training by Army and Marine Forces.[34] Direct action missions will likely increase in importance in the future and will be increasingly difficult to keep secret. SOF's comparative advantage over conventional forces and its independence are more likely to persist if disruptive innovations can be effectively developed, procured, and fielded.[35]

Disruptive Innovation

Disruptive innovations are technologies that revolutionize an industry, service, or process to such a degree that new forms of measurement are needed to capture the change.[36] The definition adopted in this monograph captures industry, economic, and policy aspects of disruption. Disruptive innovation occurs when political will exists to pursue a new capability, economic capacity exists to generate it, and policy adaptation occurs to utilize the capacity. Disruption is rare; incremental change is more commonly observed. Distinguishing between a potentially disruptive innovation and mere incremental change requires recognition that disruptive potential is not contingent upon initial success. In a business context, a disruptive innovation may initially perform worse than existing models but bring unique value propositions to the market.[37] For USSOCOM, pursuit of disruption is conditioned by high TRLs, and pressure for incremental improvements may unintentionally dissuade actors from pursuing—or realizing—truly disruptive innovation. Additionally, unlike business, where establishing market value is an innovator's priority, USSOCOM must conduct acquisition activities based on warfighter input and J5 priorities.[38] Thus, for USSOCOM, the process is inverted from standard models, which means that operators act as the market and needs identifier, creating a tautological dynamic when determining market value. This dynamic affects the operationalization of economic feasibility, as delivering capability and not simply achieving the best price, is the top priority for SOF AT&L. Weighing the various factors necessary to determine market value requires quantification of the disparate characteristics of each capability. Improvements in operationalization of market value would improve the entire acquisition process by providing objective clarity.

The broader conceptualization of disruptive innovation that incorporates economic and policy aspects is more indicative of the acquisition process faced by USSOCOM. The following section defines disruptive innovation using DOD standards and applies it to SOF. It details existing limitations in the conceptualization of disruptive innovation that may negatively affect the long-term acquisition and fielding of innovations.

Disruptive Innovation in the SOF Context

In the SOF context, disruptive innovations (or technologies) are those capabilities that "alter the balance of power on the battlefield."[39] Prominent,

modern, U.S. historical examples of disruptive innovations include aircraft carrier battlegroups, helicopter warfare, and population-based COIN.[40] Each of these innovations altered the balance of power on the battlefield, though the extent of their short- and long-term contributions to success in the strategic environment is more open to debate.[41]

Disruption as a broad concept is frequently misunderstood and misapplied.[42] Clayton Christenson's original conceptualization of disruption was specific to business, but the lessons identified in Christenson's original work have implications for the SOF community.[43] First, disruption in the business context describes "a process whereby a smaller company with fewer resources is able to successfully challenge incumbent businesses."[44] Conceptually consistent with USSOCOM's operations and position within the DOD, SOF's smaller footprint and disproportionate effectiveness parallels the characteristics of a disruptive business. Second, disruptive innovations in special operations require new measures and categorically distinct effects that distinguish these innovations from incremental improvements. Management processes must adapt to ensure acquisitions personnel are able to pursue disruptive innovations.

For Christenson, the disruption of incumbents is due to differences in how existing providers focus on incremental improvements while disruptors address overlooked market segments and emphasize functionality.[45] This is an important consideration for SOF because disruption is customizable and frequently fills previously unidentified market niches. Operators are already encouraged to act as disruptors, and the command pursues top-down and bottom-up identification of new requirements. Identification processes (and approval) for operator-driven requirements mirror Christenson's theory if SOF operators are seen as new customers for the innovation. Yet, Christenson's theory argues that "disruptive innovations don't catch on with mainstream customers until quality catches up to their standards." The high TRLs of SOF AT&L are reflective of Christenson's adoption expectations. However, concentrating on high TRLs may inadvertently diminish USSOCOM's pursuit of disruptive innovation precisely because the uncertainty of low TRLs means it could be years before value-added capabilities are fielded. Additionally, for USSOCOM, disruptive innovation requires more than simply generating new requirements and adapting commercial variants.[46] Revolutionary change will require completely new categories of requirements that challenge existing organizational norms and procurement processes.[47]

Acceptance of incremental improvements labeled as disruptive innovations may have long-term negative consequences. The first is concept stretching, which is the distortion of an existing concept. In academic and medical research, concept stretching threatens the ability to build consistent theories and test hypotheses. In the SOF context, the concept of disruptive innovation is stretched. This is done by applying the label to incremental improvements and existing policies when, in fact, the changes referred to still maintain the old paradigms, assumptions, and practices. Further, failure to correctly identify disruption by misclassifying incremental improvements generates constraints on future considerations and opportunities.[48] This is similar to the problem of the U.S. becoming path dependent once doctrine, policies, or procedures are established. Within this framework, "threat-based" approaches may skew U.S. strategy and policy by failing to identify alternative approaches.[49] Existing efforts to identify disruptive innovations and entry points for low TRL development such as innovation foundries events, Tech Tuesdays, and other SOFWERX events must ensure conceptual consistency to avoid the trap of incremental improvements misidentified as disruptive innovations. In short, the danger of concept stretching is that real opportunities for disruption will not be seized because existing incremental improvements are lauded as revolutionary changes when they are not. Disruptive innovation, as seen in technology and business spheres, requires new types of measurement.[50] In the SOF context, disruptive innovation necessitates verifying requirements and supplying capabilities fast enough to require reconceptualization of operational activities. In other contexts, disruptive innovation could involve repurposing old requirements but utilizing new technology that generates new capabilities, not simply improvements over existing methods. Development of metrics to quantify innovation would improve differentiation and identification of disruptive innovation versus incremental improvements. Identification of disruptive innovations and the study of their acquisition process will generate additional insights to support the warfighter through capability delivery.

Second, Christensen's original conceptualization of disruption emphasizes business models. In a SOF context, business models are re-conceptualized as economic feasibility. Economic feasibility is composed of two aspects: SOF as a new customer who generates demand and the industry's capacity to manufacture or supply the innovation. USSOCOM and global SOF must become customers in new industries. Development as a new customer is

more than SOF AT&L outreach to new industries or collaborative, joint engagement efforts (e.g., Special Operations Forces Industry Conference (SOFIC), SOFWERX, or the DOD's Defense Innovation Unit). USSOCOM must embrace a new customer mindset within which innovation takes the form of "simple" products at the bottom of markets and then extends to new customers.[51] Simplicity in this context is reflective of the relationship between the disruption and the existing market saturated with expensive, incremental improvements that are the hallmark of existing companies' business models. Existing methods for requirement generation require further adaptation to ensure pursuit of disruptive innovations.[52]

For SOF, economic feasibility occurs when suppliers can deliver the innovation at sufficient profit rates to expand to additional customers (e.g., the Services or international SOF). Failure to recognize and integrate the business requirements to sustain disruptive innovation undermines long-term readiness and capability. For example, one interviewed SOF AT&L KO described operator demands for a specific capability above what was procured. While the industry supplier was willing to deliver and did in fact deliver the capability prior to mission deployment, miscommunication and inconsistent processes may inadvertently have hurt short-term business sustainability by altering revenue or contracting procedures. This is likely an isolated incident, but it captures the strain on the existing procurement system to satisfy operational demands. Moreover, although this incident did not include disruptive technology per se, it was reflective of the capacity, personnel, and funding authorization limitations of the current procurement process.[53] Current operational demands remain high, but how much higher would they be in the midst of a peer or near-peer conflict? Economic feasibility requires balancing operator demands and industry engagement to enable sustained delivery of innovation.

Adoption of disruptive innovation is conditioned by two dimensions. First, adoption of disruptive innovations requires political will to initiate programs while maintaining the existing force. In eras that predominantly focused on sustainment, disruptive innovations were difficult to pursue and, even if identified, military advocates frequently cast them as incremental improvements to ensure higher-ranking officials would allow program continuation.[54] Second, militaries (and non-state actors) are likely to adopt innovations based on financial and organizational capacity.[55] The dynamics between finance and organization are such that wealthy countries frequently

have advantages in capital investment capability but are less able to adopt new organizational approaches. Innovation adoption only occurs when both financial and organizational conditions are met.

Risk aversion is a developing cultural norm that impacts both tactical and strategic decision making in pursuit of disruptive innovation.[56] The SOF community, which empowers operators to make decisions and pushes decisions down the chain of command, is not immune from a culture of adoptive risk aversion.[57] Tension between the military's dedication to developing disruptive innovation and its commitment to sustaining the Force presents a puzzle for military commanders. Fueling risk aversion are concerns that the development of disruptive innovations, by definition, takes resources away from current funding obligations; innovations are not guaranteed to bear fruit and, even if developed, innovations may not contribute to multi-domain success. Yet, investment in nascent innovations is a necessary condition for future success.

Industry Partners and Disruptive Innovation

Disruptive innovations emerge from the private sector, academic research, and government-funded activities. The U.S. is and will continue to be a global leader in innovation generation. That said, the challenge of matching technological disruptive innovation with effective policies is daunting.[58] In short, policy limitations are a major hurdle for adoption of technological disruptive innovations. This section investigates hurdles in the path of defense-specific innovation by examining how innovations are brought to market as well as the interaction between new technology and military requirements. It concludes with an analysis of SOF-peculiar challenges in disruptive innovation acquisition.

Disruptive innovations are frequently brought to market by new companies. An advantage enjoyed by a new company racing to field an innovation is that smaller, more nimble companies generally have comparatively shorter timelines from product prototyping to market entry.[59] Tech-driven innovations are most pertinent for SOF and are less likely to stall after initial phase development than other innovation strategies. Pursuit of disruptive innovation has generated numerous DOD and USSOCOM programs, activities, and initiatives to engage new partners. The goal of engagement is to integrate smaller disruptive companies into the defense marketplace. Yet, examination

of the defense marketplace, dominated by a single monopolistic consumer (DOD)[60] and historically reliant on a relatively small number of major contractors, suggests that efforts to integrate new, smaller companies, even with small business offsets, may not reliably produce disruptive innovation.

The defense market is characterized by political considerations and the consistent demand of the DOD for incremental improvement. The ongoing necessity for the military to convince political leaders to purchase transformational capabilities frequently requires engaging the lobbying power of the defense industry.[61] Development of "transformative weapons and supportive technologies will come, with few noteworthy exceptions, from the same firms that have been supplying the nation's military needs since the end of the Second World War."[62] This creates a dynamic that advantages larger, established firms over younger, innovation-focused firms—a dynamic frequently observed in other market sectors outside defense where innovative firms disrupt the market only to be overtaken by established firms that better leverage capital and capability.[63] Further, in the defense market, established firms are more likely to pursue mergers and acquisitions to increase their market share when commercial applications (and potential customers) are limited.[64]

Despite scholarly focus primarily on the Services and major acquisition categories, similar market dynamics apply to USSOCOM. First, major defense contractors will likely continue to supply incremental improvements. Overlap will continue in technology and capabilities in many areas such as platforms, logistics, defensive cyber, and other capabilities. Under the current acquisition environment, the focus of USSOCOM and the DOD on force sustainment—a focus that elevates incremental improvement—is likely to persist, potentially limiting the impact of disruptive innovations through lack of investment. Second, barriers to entry remain a primary impediment for disruptive innovation to enter the military ecosystem. Barriers to entry primarily consist of new firms having limited exposure to the FAR and limited avenues for developing relationships between industry and the military. For disruptive innovation to occur, USSOCOM must better balance engagement with disruptive firms while recognizing that major defense contractors will likely continue to provide the majority of innovation at a scale necessary for revolutionary change.

Future Operating Environment

FOE 2035 will be a multi-domain, multi-threat environment where adversaries leverage different capacities to restrict U.S. competitive advantage. Peer and near-peer competitors may match U.S. technological sophistication, and non-state actors' disruption of networks will challenge U.S. capacity to maintain operational coherence across domains (space, cyber, air, sea, and land) and dimensions (physical, cognitive, and virtual).

Drawing on existing DOD, academic, and private sector analyses,[65] this section identifies three puzzles facing the SOF community related to FOE 2035. First, the SOF axiom that humans are more important than hardware will be challenged by the changing nature of technology. Humans will remain more important than hardware, but the dynamic relationship between the two will be fundamentally different and will challenge existing conceptualizations. Second, the ability of USSOCOM to modify and utilize disruptive innovations developed for service or commercial applications will become challenging in new ways—more challenging than the modification of platforms and services in the past. Third, disruptive innovations are likely to have thorny political implications for the application of SOF capabilities with increasing demand for utilization coinciding with the option to reduce operator physical presence on the battlefield.[66]

First, humans will remain more important than hardware, but USSOCOM must consider that operator involvement is likely to look very different than it does in today's operations. The prioritization of autonomous systems and standoff capacity are essential aspects of the Third Offset framework. Prioritization of both capabilities challenges SOF operational lessons from the last decade of COIN operations where community engagement has been a necessity to achieve unilateral and "with and through" objectives. The challenge of FOE 2035 is the degree to which USSOCOM is willing to allow AI to make decisions and remove operators from harm's way with autonomous capabilities. Initially, this is an operational challenge. In the SOF context, the bigger challenge to integrating autonomous capabilities is not about the next incremental drone or weapons system but instead concerns a doctrinal question about decision making. As the deputy secretary of defense work stated in 2016, "putting AI and autonomy into the battle network is the most important thing [the DOD] can do first."[67] Once command establishes the degree to which AI can be applied, the challenge becomes more concrete

for acquisitions to deliver capabilities. Most likely, because of the nature of SOF—small teams, unique missions, difficult operational environments, etc.—their approach to leveraging AI will be distinct from the Services. The big question remains the same: is USSOCOM willing to invest in and deploy disruptive innovations that reduce the need for humans?

The HEO concept currently encompasses incremental changes. The HEO is a multi-faceted concept in which "technology at the edge helps reduce the cognitive load for operators, enhances situational awareness, improves communication and coordination with friendly forces, and enables other advanced mission capabilities."[68] The priority is on outthinking the enemy through advanced capabilities as opposed to the primarily physical augmentation pursued in TALOS.[69] HEOs will require extensive technological development and customization for SOF's distinct operational requirements. Yet, it would be a mistake to simply assume that the necessary technology will eventually become available. USSOCOM may need to tailor capabilities earlier in TRL to ensure that requirement capabilities are developed. Open architecture and capabilities customization enhance interchangeability and expected usage—if these features can be achieved. The reality is that these features represent improvements, substantial ones at that, of the existing operational framework. For HEOs to be disruptive, they must be paired with new operational practices distinct from the current environment.

Yet, it would be a mistake to simply assume that the necessary technology will eventually become available.

Humans will remain more important than hardware but not equally across domains, environments, and adversaries.[70] The assumption that SOF human presence will always be necessary restricts conceptualization of the future battlefield. Further, assuming that near-peer competitors will utilize capabilities in the same way is a strategic disadvantage.[71] AI and other disruptive innovations will reflect the culture of the society that produces them. AI developed for and by USSOCOM will instill SOF values and cultural attributes into the system. Failure to integrate SOF values during the acquisition of disruptive innovation technologies may hinder their effectiveness. Thus, differences in priorities and values across competitors will dictate the application of disruptive innovation (e.g., with regard to the prioritization of SOF operator survival and utilization of AI in kill-chain decision making).

Disruptive innovation may displace humans in unanticipated ways, and USSOCOM must prepare for that contingency.

Second, disruptive innovation in FOE 2035 will challenge USSOCOM's model of relying on Services for some acquisition. The typical model of SOF-peculiar acquisition of modified and modifiable platforms, logistics, and major services will remain and benefit from any improvements designed for the Services. The challenge of disruptive innovation is the level of customization enmeshed in the innovation, some of which is conditioned by SOF-peculiar operating environments and tactics. USSOCOM has determined that data is a resource and collection is paramount for applications of big data techniques, ML, and AI.[72] USSOCOM's creation of PEO SOF digital applications supports the collection, analysis, and leveraging of data across the various USSOCOM core activities. This organizational innovation is pivotal as the disruptive technologies in one area, such as AI in facial recognition, do not necessarily transfer capability into other areas. For example, development of autonomous cars does not necessarily translate into autonomous support vehicles in the conditions experienced by SOF. Decision making in city traffic is clearly distinct from the environmental challenges faced by SOF. Similarly, particularly with ML where data input conditions output, there will be delays and incompatibilities when applying Service-inspired and commercially supplied innovation to SOF contexts. As USSOCOM crafts its new AI policy, existing command resources (e.g., the Command Data Office and Data Governance Board) should be leveraged to facilitate coordination and implementation of policies across the command.[73]

Cultural knowledge and engagement capacity are a distinct SOF capability and perhaps the most challenging area for disruptive technology adoption and adaptation. In one emerging area, cloud-based real-time language translation, the implications (and limitations) for SOF-peculiar applications are identifiable.[74] Commercially developed real-time language translation is rapidly progressing and likely fieldable now for common languages (e.g., English, French, Spanish, etc.) when sufficient bandwidth and cloud capacity are available. But for SOF operations, limited commercial engagement with the languages and dialects encountered by operators will continue to necessitate operator language proficiency. SOF acquisition must continue to adapt to the commercial market, including specifically designed contracts to provide the AI training for the existing commercial product in the languages needed by operators. Existing contract processes can accommodate this

specialization despite challenges in pricing, cost of AI training, and human language expertise. In this example, identification of fair price, completion metrics, sole-sourcing hurdles, and network-integration hurdles can be overcome through adaptative acquisition models (e.g., other transaction authorities [OTAs] and adapting request-for-information solicitations). Continued adaptation of the acquisitions processes to develop and acquire AI without commercial applications may pose more challenges.

Third, disruptive innovations will alter the dynamics between political decision making and SOF employment in FOE 2035 such that the SOF usage rate is likely to increase. A high SOF usage rate over the past 15 years of COIN operations has already strained the Force—personnel, families, and resources.[75] Disruptive innovation may increase the SOF usage rate as the threshold criteria for use of military force are reduced. Disruptive technology will likely reduce the human footprint of SOF operations, resulting in an increase in the frequency with which SOF are utilized. This is particularly likely in gray zones where the U.S. is "confronted with ambiguity on the nature of the conflict, the parties involved, and the validity of the legal and political claims at stake."[76] Consistent with U.S. policy, near-peer adversaries in gray zones leverage increasingly sophisticated information-gathering, cultural, and financial activities.[77]

SOF participation in clandestine operations will also likely increase as peer and near-peer competitors increasingly employ covert forces and incentives to avoid escalation of conventional conflict.[78] According to Carson, even when detected, covert activities are often not publicly acknowledged or countered, as each major power seeks to limit escalation.[79] This is a change from clandestine operations that are designed to remain hidden from the general public and from the enemy but in which the identities of the forces involved are not secret and public acknowledgement may occur. Conducting gray zone activities backstage, outside any acknowledged government policy and outside the realm of public acknowledgement, if not out of the headlines, insulates leaders from domestic pressures for escalation. Such gray zone interventions—visible yet unacknowledged—can be potentially beneficial as a mechanism for communicating the resolve and, at the same time, the restraint of the intervening powers.[80] Gray zone conflicts and the U.S. desire to avoid escalation of conventional conflict increase the likelihood of SOF future deployments to address threats and disputes relevant to national security but below the threshold for major conflict escalation.

Disruptive technology, particularly open-source, transparent, real-time predictive analytics, will increase the number of stakeholders present in gray zones. [81] Predicting conflict initiation, social breakdown, political revolutions, and other socio-political activities enables groups (e.g., governments, nongovernmental organizations, intergovernmental organizations, and militaries) to identify hotspots with increasing accuracy, eroding the information advantage once enjoyed by large state intelligence agencies. In short, the FOE 2035 landscape will be more cluttered than the current landscape with more opponents with roughly equal capabilities.

In sum, multiple implications of FOE 2035 relate to acquisition challenges, existing assumptions, and models of SOF. First, once USSOCOM leadership identifies and substantially establishes a framework for disruptive innovation (e.g., use of innovations in the kill chain), SOF AT&L will face technical and bureaucratic challenges. Acceptance of partial objective completion—such as the TALOS program with its goal of reducing danger for the operator who is first through the door—may become more necessary over time.[82] However, a danger for the SOF community lies in not pushing the envelope far enough in rethinking its acquisition processes or not developing SOF-peculiar technical capabilities to address capability needs. Second, FOE 2035 data pervades all domains and SOF core responsibilities. USSOCOM may struggle to adapt techniques that are not specific to SOF operational conditions, missions, and decision-making processes (e.g., service-provided AI, ML, and deep learning).[83] In the areas of logistics, defensive cyber, troop support, HR, and law, adaptation of non-SOF specific techniques may be effective. That said, SOF AT&L should consider additional resources and capabilities dedicated to areas such as enabling data collection and analysis in SOF-specific contexts.

Summary and Implications

Challenges to U.S. competitive advantage are substantial and likely to accelerate in the future. Domestic limitations cascade from inconsistent federal budgeting processes, declining national R&D spending as a percentage of global spending, and limited, national-level planning to pursue disruptive innovations. USSOCOM's limited R&D capacity ensures that technology adaptation, not customized development, will be the norm for acquisition of disruptive innovations. Global R&D and capability are increasing, as are grey zone competitions, putting operators in more frequent contact with peer and

near-peer rivals with similar technological capabilities. The assumption that U.S. competitive advantage will persist into the future must be thoroughly questioned, and SOF acquisition activities must adjust to fighting a future rival with near equal capabilities.

Disruptive innovations generate new measurement methods to capture their effects. Incremental improvements are important but do not constitute the revolutionary change that is essential if USSOCOM is to discover and invest in the winning capabilities of tomorrow. USSOCOM must act as a new customer for firms that have little or no prior experience with defense contracting. Treating incremental changes as revolutionary runs the risk of impeding new thinking about innovation and may result in missed opportunities that put SOF behind the innovation curve. In some instances, revolutionary changes developed within the Services are treated as incremental changes to avoid potential friction with command.[84] These instances speak to the difficulty of aligning political will, economic feasibility, and policy management to deliver disruptive innovation. Organizational flexibility, creativity, and willingness to adapt—hallmarks of SOF—should define the USSOCOM acquisition process with a view to maintaining SOF's superiority over near-peer rivals.

Partnership with technology developers will define USSOCOM access to disruptive innovation. The defense industry's history suggests that incremental changes currently witnessed in acquisition will likely continue to be provided by major defense contractors. Integration of new partners and capabilities will necessitate expanding the industrial base, particularly for commercial-off-the-shelf items (COTS). USSOCOM's existing efforts to integrate small businesses, establish collaborative opportunities, and conduct industry outreach are necessary to identify disruptors. The true test of the acquisition process will be its track record of investing in innovations when others do not see their potential—because conventional forces cannot identify the benefits or are unwilling to accept the risk of failure.

The SOF usage rate will likely remain steady or accelerate in FOE 2035. Operators will remain the most important aspect of SOF, but disruptive innovation will augment their capabilities. Customization of disruptive innovations for SOF-peculiar environments will face more challenges in the future compared to current and previous modification efforts. USSOCOM will continue to benefit from general advances in disruptive innovations that easily transfer among large organizations (e.g., in areas such as logistics, management, legal, medical, and systems integration, etc.).

Chapter 2. Acquisition and Procurement of Disruptive Technologies

SOF AT&L is arguably one of the best acquisitions and procurement units in the federal government. SOF procurement personnel are individually and collectively highly productive when measured by actions per person, dollar amounts, and effective competition rates.[85] This productivity—coupled with substantial differences in budget, personnel, acquisition categories,[86] TRLs, and mission focus—is a comparative advantage the DOD lacks.[87] The reorganization of SOF AT&L over the recent decades of the Global War on Terrorism addressed structural weaknesses that existed in funding authorities, decision making, and operations.[88] SOF AT&L's excellence in sustaining the Force, despite a decade of constantly high usage, burn rates, and geographic expansion, is a testament to the organization's bureaucratic strength.[89] Adapting the organization to handle challenges posed by disruptive innovations will require the leadership, decision making, and flexibility that are hallmarks of the SOF community. The following section concentrates on procurement and contracting processes. Disruptive innovation primarily occurs prior to contracting activities as acquisition personnel generate solutions for verified requirements. Procurement processes are integral to the acquisition ecosystem because they represent a conceptual end point, enabling "field to learn" initiatives and capability delivery.[90]

The following analysis emphasizes the interaction between disruptive innovation and the existing bureaucratic acquisition infrastructure. Tracing a brief history of SOF AT&L decision making reveals a consistent and constant effort to streamline the organization, elevate and empower individuals, and execute mission requirements.[91] These characteristics must be employed in new ways to modify procedures and processes to enable acquisition of disruptive innovations now and in FOE 2035. Procurement of disruptive innovation is now a strategic function that will differentiate competing organizations.[92] Acquisition of disruptive technology is not a straightforward process. Simply identifying top DOD technical priorities remains elusive, causing duplication, funding instability, and inconsistent strategic planning.[93] One implication from this inconsistency is that the assumption of the Third Offset, particularly that the U.S. will retain technological superiority against

a peer or near peer, may not hold in the future.[94] Failure to adequately pursue, develop, and integrate disruptive innovations will impair multiple core SOF mission functionalities and substantially reduce effectiveness against peer and near-peer rivals.

The analysis in the following section examines DOD efforts at acquisition of disruptive innovation and their implications for SOF. First, SOF AT&L's continued adaptation to the changing workforce personnel requirements and application of commercial AI in legal reviews are analyzed. Second, currently unavailable alternative business models between the public and private sector and their potential compatibility under the FAR are examined to identify potential collaborative arrangements that are currently underutilized. Public-private partnerships (PPPs) are not an option under the FAR, but lessons from international examples can contribute to innovative acquisition policies. This section concludes with a brief discussion of revolutionary changes occurring within commercial procurement divisions and their possible application to SOF acquisition.

Organizational Alterations (Conceptual and Structural)

SOF AT&L is an effective organization, and procurement has a critical role in the acquisition process. The following analysis examines procurement processes in the context of the larger acquisition activity to identify opportunities for improvement in conceptualization of performance and procurement's role in the process.

Improved conceptualization and measurement of procurement performance will accelerate procurement and enable cross-time performance evaluation. Existing measures of performance are typically reduced to tallies of contracts and contract dollars awarded. These metrics yield a picture of high proficiency on the part of SOF AT&L compared to Service organizations. The metrics are consistent with the perspective that establishing timelines for work completion may emphasize arbitrary deadlines instead of pushing personnel to complete tasks as quickly as possible. Indeed, establishing "standard" timelines or expectations in SOF environments is likely difficult and potentially counterproductive. Instead, SOF-specific metrics that better account for contribution to the warfighter must be developed.

Development of additional metrics to capture procurement personnel performance will improve organizational capability. First, performance

metrics tailored to SOF procurement will provide benchmarks necessary for managerial decisions. Standard existing metrics—such as time to completion, including legal review, billets available, contracts executed, etc.—are macro indicators of overall performance. Yet, standard measures may not effectively capture the SOF procurement context. For example, one common limitation identified by contracting personnel was delays at the point of contract completion caused by how an acquisition was structured. While the opportunity to attend collaborative meetings on acquisition is available and supported by leadership, actual attendance is low. Conceptualizing and developing a metric to capture effectiveness at avoiding foreseeable delays improves capability delivery. The measure has to capture the absence of something (e.g., delays) since dichotomous measures of success are insufficiently flexible to enable additional analysis.[95]

Workforce sustainment is a second incentive to develop improved procurement performance metrics. A common theme from interviews with procurement personnel was the simultaneous importance of contributing to the mission and the difficulty of measuring their contribution. The individual team member's emphasis on contributing to the mission is endemic of SOF culture and indeed a significant factor mentioned by several interviewees as they explained their career choice. Conceptualizing operational impact beyond simple time to delivery faces several challenges. For example, it is difficult to conceptualize and measure what, if anything, a particular service, product, or capability may contribute to a specific mission. Additionally, any data collection undertaken in this effort must only minimally add additional time constraints to operators. Cumbersome reviews used in the private sector are not an option. Using interview data to identify key concepts invoked by operators themselves may be an initial step toward developing new measurement tools.

Digital media and tools enable management to utilize data more effectively than was possible in prior eras—if performance and impact data are in fact identified and collected. SOF AT&L, specifically the procurement directorate, must harness contemporary data analytics to ensure that speed and relevance are maintained.

Reconceptualizing Resource Limitations

Inconsistent conceptualization also contributes to a broader phenomenon: interviewees frequently identified significant resource limitations that impaired performance while simultaneously voicing their commitment to constantly succeed.[96] These two points are mutually exclusive: either there are sufficient resources to complete the task or there are not. In the broadest sense, success for SOF AT&L is the provision of capabilities to SOF warfighters. Success in procurement activity, at least currently, is typically measured in time to completion or some aspect of contracts or dollars awarded. In both instances of success, the metric does not fully capture potential limitations in the process. Undoubtedly, SOF AT&L-K personnel fill the gap between resource limitations and mission requirements through their dedication, creativity, and professionalism. The simply dichotomous measure of capability delivered or not delivered may miss important features of the process and reduce management's ability to fully understand and improve processes.

It is also important to note that not all interviewees who indicated the existence of resource limitations also indicated that resource limitations had caused problems or failures. A plausible explanation could be that, often, operators are able to leverage their ingenuity and persistence to find solutions. Yet, it would be a mistake not to flag this state of affairs as a potentially serious systemic problem. The potential danger for procurement activities is that reliance on personnel to fill gaps and find solutions alleviates problems in the short term, but a significant uptick in operational tempo may exacerbate underlying problems and end up reducing the ability to reliably deliver capabilities to the Force.

Recognition of failure and documenting it as such is a necessary step in procurement activity to effectively gauge an organization's capability.[97] In many instances, acknowledgment of failure in acquisition is focused on the technical side: did the product deliver the capability? Along these lines, a recent Navy exercise that involved fielding advanced capabilities was deemed "successful" despite the exercise's explicit goal of pushing technical envelopes. Indeed, the exercise's high rate of success was criticized by the commanding officer because, in the absence of any instances of capability failure, the commanding officer was not confident that technical frontiers had in fact been tested.

Another type of failure is related to the procurement process and the toll on the workforce to deliver the capability. In the case of procurement personnel, evidence of process strain manifests in employee burnout and turnover that hurt organizational efficiency and resiliency. Additionally, several interviewees articulated that AE assistance in moving procurement activities forward is used more frequently than they would expect. To be clear, AE involvement is typically reserved for time-sensitive and high-risk instances, not everyday workflow-related actions. While additional analysis is necessary to establish additional metrics and determine what reasonable performance expectations connected to operational outcomes could be, the incompatibility of perceived severe resource constraints and a high success rate will continue to limit reform and process innovation as long as underlying problems are not identified and addressed.[98]

Structural Adjustments

Acquisition of disruptive innovations requires workforce alignment with strategic objectives. SOF AT&L's extensive track record of success demonstrates consistent delivery of capabilities. Workforce quality and experience are critical in the acquisition of disruptive innovation because of the decentralized decision-making process. Acquisition of disruptive innovation requires individuals to implement solutions for verified requirements within the existing bureaucratic constraints. Experience, knowledge, and networking are necessary attributes for organizational adaptation. Creativity, such as utilizing new technologies that generate a capability that necessitates a new type of measurement of its contribution—a critical component of disruptive innovation—requires adaptability across acquisition processes. The critical role of individual personnel within the process elevates workforce management as a key component in a long-term strategy to delivery disruptive innovation.

Yet, consistent with USSOCOM as a whole, SOF AT&L organizational resiliency is strained from over a decade of high-tempo operations.[99] Failure to adapt to current and future workplace trends will decrease efficiency, diminish surge capacity, and potentially degrade the ability to complete duties. This section focuses on the workforce and perceptions of operations based on interviews conducted with members of the procurement directorate in 2019.[100] The interviews capture dynamics in the workforce that challenge

longstanding assumptions that govern personnel management. First, human resource concerns spanning the federal government are applicable to USSOCOM.[101] The federal workforce is aging rapidly, and millennials and Generation X have different workplace expectations and loyalty to employers than prior generations.[102] The assumption that SOF AT&L will be able to consistently recruit and retain personnel may be challenged in the future. The importance of mission, organizational culture, and other professional benefits are draws for candidates and increase retention.[103] Yet, it is precisely the mix of skills and experience that make SOF AT&L personnel so desirable for outside organizations. Failure to adapt to changing work environments threatens the continuity of services.

Second, the trade-off between a flat organizational structure and personnel development may change over time. The benefits of a flat organizational structure (e.g., pushing down decision authority, direct access to personnel integration of operators, short decision chains, etc.[104]) are essential to the speed associated with SOF acquisition. The known limitations of this approach versus its benefits may shift over time because of constraints in human resource allocation. Limitations in promotion opportunities, comparatively few management positions, short military rotations, and changing workforce loyalty increase turnover, which is already heightened by the demanding environment.[105] Third, the demand for legal services forms a bottleneck in the contracting process. Legal support is frequently related to questions on authorities and liabilities compared to contract language. Hiring additional lawyers is one option because the bottleneck is generated by high demand and low supply of legal expertise. Alternatively, this section identifies emerging technologies as another possible solution. Each of these four areas offer opportunities for minor adjustments in organizational structure that will yield improved capability and increased resiliency.

Failure to adapt to changing work environments threatens the continuity of services.

First, human resource concerns affecting the federal government—mass baby boomer retirement, millennial management differences, and organizational loyalty—also apply to SOF AT&L. The SOF community has been largely insulated from federal employee trends over the last two decades because of its elite status, specifically its ability to recruit skilled and motivated operators from the Services through rigorous examination and high

barriers to entry. Operators have been attracted by the perception of elite status found within all areas of the SOF community. The quality of SOF AT&L personnel is not in question. What deserves attention is the reality that the combination of elite status and mission importance does not insulate SOF AT&L from adapting to contemporary workforce trends and preferences.[106] The perception that high-quality employees will constantly seek opportunities to participate in SOF's missions should not be taken for granted if humans are more important than hardware.

Limitations in workforce adaptation are apparent in two areas: work location flexibility and millennial and Generation X employee engagement. First, across interviews, the most common KO concern was the lack of telework opportunities in USSOCOM—a concern that already existed under certain conditions in other DOD areas and the federal government in classified and non-classified settings.[107] Subsequent to the interviews conducted for this monograph, telework was introduced and was in-place prior to the 2020 SARS-CoV-2 (COVID-19) pandemic. The new telework policies are customizable both in terms of days in and out of the office as well as with regard to employee output during each day's activities.

Addressing the telework situation highlights how measuring an outcome matters for workforce management. On the one hand, the new telework policy was brought up to DOD and federal standards and provided benefits to personnel. If the operationalization of success is simply that a policy change occurred, then the policy adaptation was a success. However, another measure of success focusing on rate of change suggests SOF AT&L was comparatively slow in adopting the new policy relative to other agencies that already had the policy.[108] Moreover, if a policy's success is measured in terms of its impact, what is to be made of the fact that only about 50 percent of procurement personnel eligible for telework accommodations opted to utilize the policy? This is a surprisingly low participation rate given the much higher rate at which individuals campaigned for the flexibility of a telework policy. One possible explanation is that disruptions brought on by the COVID-19 pandemic reduced the advantages of working from home.[109]

The presence or absence of telework should not by itself affect the acquisition of disruptive innovation. It is highly unlikely that the lack of telework caused someone to leave the organization or that the new telework policy was sufficient to retain an individual. Instead, the important insight here is that telework could easily have been implemented earlier, consistent with DOD

policies, had command leadership decided to do so. Millennial, Generation X, and future Generation Z workers are distinct from baby boomers; on average, they demand more flexibility and exhibit less organizational loyalty.[110] USSOCOM is not immune to workforce challenges and limited responses to such constraints will negatively impact its workforce.

Second, SOF AT&L's flat organizational structure delivers at the speed of relevance. Consistent access to all levels of the command improves organizational efficiency in the macro setting. However, the flat organizational structure negatively impacts employee retention in contracting personnel. Furthermore, outside businesses' easy access to SOF AT&L personnel, in some cases, negatively impacts efficiency. SOF contracting personnel, because of the high level of competence required in the high-demand field, are highly sought after by other federal government contracting entities. Because of the limited number of managerial spots and consistency in the general schedule pay scale, there is little room for professional advancement. Consequently, talented individuals frequently leave the organization seeking promotion and opportunities elsewhere. Multiple interviewees metaphorically described SOF AT&L as a farm league system for the DOD and the General Services Administration. SOF-related experience is a valuable career credential that is frequently maximized outside of the SOF community. Diminished organizational loyalty in the changing workforce will likely exacerbate these retention issues.[111] Because major shifts in organizational structure are unlikely to occur, accommodations to improve retention must be considered.

The flat organizational structure enables quick, efficient interaction between the SOF community and the private sector but generates negative externalities for personnel management. The rapid response of SOF AT&L personnel is critical in their success, as identified by participants at the 2017 SOFIC.[112] Yet, the ease-of-access pendulum may have swung too far in favor of businesses. Multiple interviewees working at Headquarters (HQ) USSOCOM discussed the extensive time commitment required to respond to and engage with businesses, with entire workdays sometimes devoted to answering basic email queries.[113] Commercial innovation should not only be pursued for the operator but also implemented for the organization. Regarding email, many interviewees estimated that the majority of the messages they sent were responses to routine inquiries or clarifications. In the private sector, these types of interactions are increasingly automated. Advancements in AI power customer service capabilities, and these mature

capabilities could be adapted for the SOF environment. Pursuit and integration of emailed scanning and response capabilities will substantially increase personnel time availability. Magnification of benefits occur when identification of repeated patterns of waste are addressed through upstream diagnostic analysis. For example, in the private sector, Expedia's upstream diagnostic analysis of customer calls yielded substantial savings. The company's siloed structure (i.e., company unit objectives not overlapping and causing decision implications to be localized to each unit despite company-wide impact) generated customer-service inefficiencies. Through an upstream diagnostic analysis, Expedia identified that nearly 50 percent of customer calls were related to basic reservation information and minor adjustments to initial communications. Consequently, automation of certain types of inquires saved hundreds of millions of dollars in the first year of implementation.[114] For SOF AT&L-K the financial incentives to address personnel management issues are smaller but so too are implementation costs, particularly as commercialization of AI-assisted customer service capabilities advances. Retaining the benefits of the flat organizational structure necessitates adoption of innovations or acceptance of growing inefficiencies.

One final aspect of flat organizational structure is the limited resources dedicated to developing new measures of individual impact. What is the value of acquisition for SOF operations? At one level, leadership and commanders acknowledge the crucial importance of acquisition, but at another level, contracting personnel typically lack direct measures of their impact.[115] Metrics connecting acquisition activities to operational impact are essential to demonstrate and communicate SOF AT&L-K personnel contributions. Further, development of metrics may improve acceptance and utilization of TSOC and other non-HQ based personnel.

Third, lawyers are essential in any bureaucracy, and SOF AT&L is no exception.[116] Legal review is one bottleneck in procurement activities where commercial AI can be adopted—and, as necessary, adapted—to speed up processes to ensure timely procurement of disruptive innovations.[117] The development of AI-based contract processing is now extending to different areas of contract writing and review in the private sector. The following section outlines improvements in AI-based legal support and identifies how commercially available AI systems could be adapted to the SOF environment and prove beneficial.

Commercial AI is currently applied to contract review in the commercial world.[118] Contract writing and review are not the duties of the lawyers as those duties fall to contracting personnel. Yet, commercial AI may be applied to other duties shouldered by the legal team, thereby freeing up time for personnel to focus on SOF-peculiar activities. For example, existing commercial software is applying ML to improve review of non-disclosure agreements (NDAs) and other common business contracts.[119] Early evidence suggests that AI-powered contract reviews are more effective at identifying contract anomalies than human lawyers.[120] NDAs are necessary for SOF acquisition activity, though admittedly, NDAs constitute only a minor percentage of all legal services. The potential improvement powered by AI-assisted legal services is possible, customizable to SOF environments, and may improve efficiency.[121]

Trust is the key obstacle to implementing AI-assisted legal analysis. Trust, in this context, pertains both to the matter of trusting that an AI legal review will be accurate and effective as well as trust by USSOCOM that investing in a currently unproven capability will ultimately benefit the organization. First, trust in AI capability is the demonstration that AI is more effective than humans at the task, which has occurred in other AI applications.[122] Establishing trust among lawyers that commercially adapted AI capabilities can effectively review contracts will be a time-consuming and costly process given that lawyers will have to review AI decisions and act as coders for the ML process. Second, USSOCOM must trust that investments in AI will produce significant future benefits. Currently there is limited, if any, discussion about new requirements or acquisition activity related to legal AI. Yet, SOF AT&L must think beyond solving today's issues with current solutions to effectively compete in the future. AI-assisted legal departments will be the norm in the future. The SOF community would benefit from early entrance into customization and application of AI.

Public-Private Partnerships in Defense

PPPs often involve bundling the development of a new service with the provision of that service.[123] PPP is differentiated from traditional procurement because of the government's ownership stake in the firm. This ownership stake changes a firm's incentives and is the catalyst for utility differences between the two approaches.[124] Unlike traditional procurement, PPP requires

initial contractor investment to gather information about the likely costs, revenue, and profit involved in managing the contract. This arrangement benefits the government given that it limits the government's initial fiscal commitment. When the service is an infrastructure-related activity, PPP are likely to increase a contractor's cost-reducing investments.[125] With regard to the development of disruptive technologies, PPP are likely to attract contractors who see the potential application of a new disruptive technology to civilian contexts. This scenario expands the ecosystem of potential PPP contractors and contributors and requires USSOCOM to intentionally spin in innovation providers.[126] In very specific situations where a particular requirement is deemed mandatory for future operations and the expectation is that the usual acquisition process is unlikely to yield the desired capability, PPP offer USSOCOM an avenue to influence technological development from the earliest stages.

USSOCOM's process for identification and approval of new requirements remains one of the most efficient in the DOD. Both operator-led identification and the J8 (requirements and resources directorate)-generated processes ensure a reliable and effective procedure for delivering timely requirements for acquisition. At the same time, a focus on current missions and short timelines contributes to limitations in the requirement-development process including insufficient cross-team collaboration.[127] To harness disruptive innovation, the J8 must simultaneously enlarge its vision beyond just narrowly supporting today's missions and invest in capabilities to satisfy future requirements. This is a fundamental shift that is only appropriate when one or more specific disruptive innovations are so critical to future operations that failure to develop them would be catastrophic or when a peer or near-peer is on the brink of developing them and thereby gaining a decisive advantage. Specific partnerships to deliver desired capabilities are one approach to ensure that U.S. SOF maintain their technological edge.

There are several models of PPP that offer insights for USSOCOM. The first and least likely to occur is true PPP where the government takes a stake in the company. Defense PPPs have a distinctive feature: the government is both the main shareholder and the major (sometimes only) customer. The government as owner and consumer has distinct consequences for contracting, negotiation, and operation. The government gains leverage over the PPP by controlling objectives that reduce conflicts of interest and thereby limit opportunistic behavior by the firm. Yet, PPPs are hampered by difficulty

renegotiating long-term contracts, and opportunistic behavior may increase in the PPP due to the government's dependence on the PPP and lack of additional customers.[128] European style PPPs are more limited in the U.S., but lessons learned from these types of collaborations remain applicable to general acquisition strategies.

The CIA's In-Q-Tel is a forward-leaning investment vehicle designed to fund, develop, and utilize disruptive innovations. IN-Q-Tel's founding in 1999 was designed to enhance early entrance and influence technology development in recognition of the technological advancements made in government-sponsored facilities.[129] Essential venture-capital funds enable the CIA to invest in potentially disruptive technology, specify R&D priorities, and tailor risk-reward and profitability incentives. Early investment also helps avoid the scenario in which a firm decides it is hesitant to engage in government-related security, espionage, or military business then withdraws or restricts its participation.[130] The implications for USSOCOM from the lessons of In-Q-Tel's success pertain especially to the importance of early entry in technology development. USSOCOM will not be a primary driver of R&D in the private sector or act as an agenda setter within the DOD. USSOCOM's budget is simply not sufficient. Instead, the takeaway from In-Q-Tel is that identification of specific technologies and targeted investment in those technologies can influence outputs. Public and private R&D aimed at developing disruptive innovations are not designed for SOF-peculiar applications. Instead, under the current model, disruptions will be tailored to fit SOF needs after creation. The difference between influencing innovation development and adapting innovations is significant.[131] SOF-peculiar requirements must be integrated into disruptive innovations at the beginning of the process or risk failing to adapt to SOF environments. Unlike the DOD or CIA, where funding is comparatively unlimited, if the J8 has identified a key disruptive innovation essential to future operations, a private-public collaboration is one plausible approach to delivering the capability.

USSOCOM has not had much experience with early partnerships and company investment in the venture capital mold; however, expanding activity in this area may be necessary if SOF-peculiar disruptive innovations are to be developed and procured. USSOCOM spending capacity is simply too small to significantly shape technological trajectories. Thus, partnerships offer a viable though limited opportunity for influence. The analysis suggests that, without structural changes to acquisition in early technology

investments, USSOCOM will be hampered in tailoring disruptive innovation to SOF-peculiar applications. However, the structural changes in terms of rules, regulations, and dollars will be difficult to implement, and political resistance will be difficult to overcome given that return on investment is unpredictable. Unfortunately, the two SOF examples of SOF PPPs—SOFWERX and TALOS—do not suggest that existing structures and processes are well suited to forging such partnerships with business.

SOFWERX is "a public facing emissary that facilitates collaboration, innovation, prototyping and exploration with industry, labs, academia, and government stakeholders."[132] The organization is technically a non-profit entity that specializes in rapid acquisition to address operator needs. The organization uses combinations of challenges, prize competitions, and rapid prototyping mechanisms to address operator needs. Broadly effective in its directive, the organization's objectives are to deliver immediate impact by tweaking existing equipment or performing additional post-development capacities. That said, the organization lacks the funding and authority to pursue disruptive innovation at formative steps as identified above.

The TALOS program instituted a distinct public-private arrangement with the government acting as lead integrator. TALOS successfully spun off components to support operators.[133] Leaving aside the substantial technical hurdles of this kind of project, having the government play the role of lead integrator of systems is difficult. The government's ability to play this role is generally limited by factors such as lack of government technical capacity, closed (proprietary) systems architecture, and commercial-government incentive incapability.[134] Still, TALOS improved SOF engagement with business and provides an example of a type of PPP that integrates advanced technologies within the acquisition process.

The essential goal of PPPs is to deliver a disruptive innovation as it is needed by the SOF community. As the TALOS example illustrates, a program that experiments with new technologies and acquisition authorities can be devised to deliver capabilities for a clearly defined need (e.g., protecting operators that are first through the door). An important lesson from the TALOS example is that a clear objective is generally necessary if progress is to be made with disruptive innovations. If USSOCOM distills insights and experience in any area of disruption into a clear SOF-peculiar objective as the TALOS program did, PPPs may become a reliable avenue to develop and deliver new capabilities. "SOF-peculiar" is a key qualifier here: what do SOF

need that the DOD or industry is unlikely to pursue on its own? If the SOF community identifies a unique SOF-peculiar capability, it will have a clear basis for pursuing a PPP. The necessary bureaucratic, legal, and congressional action necessary to establish a PPP will require substantial advocacy, time, and energy. That being said, if a requirement is identified as critical for FOE 2035, failure to pursue it could be rightly portrayed as a decision that imperils the future force.

Insights from Private-Sector Procurement Success

Commercial procurement benefits from the speed of competition. SOF AT&L-K must innovate within the FAR and DOD framework, which sets some limiting conditions on adaptability. Over the last decades, the Government Accountability Office (GAO) established 12 significant recommendations for the modernization of DOD business systems. DOD business systems investments in fiscal year 2020 exceed $8.9 billion, but the DOD has implemented only 4 of the 12 suggested reforms.[135] Notably for SOF AT&L, none of the five recommendations to develop and maintain business and information technology (IT) enterprise architecture have been addressed. This section focuses on GAO recommendations to improve procurement processes and IT capability to improve SOF AT&L's overall business processes.[136] The GAO's recommendations focus on the DOD but provide context for the analysis of SOF AT&L-specific areas for improvement.

Recommendations for procurement system improvement include procure-to-pay (P2P) business processes. P2P encompasses the entire process from executing a procurement requirement to closeout. OTAs are one method to improve prototyping and potentially accelerate procurement. Since the 2016 National Defense Authorization Act, OTAs have become increasingly common across the DOD.[137] The increasing awareness of and praise for OTAs has generated a situation where management is motivated to report the use of OTAs without necessarily analyzing their effectiveness. Potential incentive incompatibilities between management and workforce—instances where management benefits from a record of using OTAs while the workforce in fact loses time learning and implementing them—do not necessarily mean OTAs are ineffective. However, without an effective system to track and evaluate business system performance, a thorough empirical evaluation of OTAs cannot be completed to determine if OTAs are comparatively

efficient. If OTAs are used as designed to facilitate creative and targeted procurement activities, incentives for management and workforce will align over time, resulting in improved organization efficiency.

IT capability is essential for business system integration. SOF AT&L cannot maintain its world-class organization status with outdated and inconsistent IT capacity. Currently, multiple software programs for P2P operate in isolation. This imposes significant time costs on tasks—even relatively simple, routine tasks—that involve more than one software.[138] If SOF AT&L is to adapt to the commercial pace of procurement, integrating and streamlining all P2P into a single, cloud-based system is necessary. Such integration and streamlining will improve acquisition processes across the board and at all levels.

To emulate the commercial pace of procurement, SOF AT&L must adapt to new ecosystems. Commercial integrated systems exist that streamline decision making, processing, payment, tracking, and contract closure. A single-platform system generates two benefits identified by KOs. First, contract handoffs in the current system are ad hoc—some come with extensive detail and information while others lack information to quickly spin-up the new KO. Second, a single system simplifies contract closeouts.[139] Similar to other business functions in the commercial sector, procurement activities are undergoing disruption from innovative start-ups. Start-up companies are pushing features to improve efficiency including native mobility and built-in social collaborations within platforms that insulate all activity within firewalls while enhancing employee productivity.[140] SOF AT&L has an opportunity to revolutionize acquisition processes if it is willing to embrace structural innovations.

Disruptive innovation will impact all facets of SOF AT&L activity. The question is how quickly those adaptations will occur. SOF AT&L's ability to shift acquisition activity to expedited timelines has been an organizational strength. SOF's acquisition culture of pursuing revolutionary capabilities for the warfighter should be generalized to its supporting organizations. Failing to pursue adaptation and innovation in acquisition activity undermines SOF effectiveness over time.

Summary and Implications

SOF AT&L is one of the best acquisition units in the government. Consequently, research and review efforts have tended to address specific points of possible adjustment or alteration to improve efficiency as opposed to investigating the pros and cons of more extensive structural changes. Yet, minor changes can have significant impact on acquisition processes and ultimately SOF operations. The military is renowned for extensive operational alternative planning, but that is distinct from planning for disruptions from global events such as the COVID-19 pandemic. The pandemic focused attention on the issue of resiliency—or the lack thereof—in civilian and military supply chains.[141] In organizations under stress, even minor improvements in capability can greatly improve performance.

Human resource improvements also offer opportunities to improve organizational performance. First, continued streamlining of procurement activity to only essential actions can help consolidate personnel workforce efforts. Second, SOF personnel's dedication to mission and affinity for SOF-peculiar support are enhanced by generating metrics that connect contracting activity to operational outcomes. Continued identification of advancement opportunities inside of SOF AT&L (though not necessarily within the same unit) will also promote talent retention when units have flat organizational structures.

Chapter 3. Case Studies: Social Media, Artificial Intelligence, and Machine Learning

Disruptive innovations are technologies that so completely change a capability, service, or industry that a new system of measurement is necessary to capture the affects. In the SOF context, disruptive innovations can take many forms. For example, future SOF operating environments will harness disruptive innovations to individualize intelligence, messaging, and engagement in disparate cultural, social, and political contexts. Acquisition of disruptive innovation in social media and open-source intelligence more generally will require more nuance, not less, as systems generate culturally specific and individualized biometric outputs. In this analysis, disruptive innovation is considered in areas of social engagement where AI/ML is harnessed to enable adaptive, anthropologically tailored information processing in real time to benefit operators. The analysis is intentionally slanted to emphasize acquisition and procurement processes.

For example, future SOF operating environments will harness disruptive innovations to individualize intelligence, messaging, and engagement in disparate cultural, social, and political contexts.

Extending beyond trend analysis, social media engagement requires the "ability to tell our message in clear text to a population … [which] is a core competency for us," according to current USSOCOM acquisition executive Jim Smith.[142] The scenario analyzed below is an extension of the transformations SOF Task Force 714 experienced during the Iraq War. According to Richard H. Shultz and General Richard D. Clarke, Task Force 714 transformed into an intelligence-driven, big-data producing and consuming organization that expedited mission tempo.[143] The following section contextualizes USSOCOM's potential role in developing social media and open-source capabilities. USSOCOM is uniquely positioned to undertake such disruptive innovation initiatives because of its acquisition processes that emphasize collaboration with the private sector, unique multi-source data

harvesting suitable for algorithm training, and SOF-peculiar application of intelligence capability unlikely to be developed by the Services. The following section examines the operational need for such social media capabilities before analyzing the acquisition opportunities.

Operational Imperative

The dissemination of propaganda through social media, either by state or non-state actors, and its potential influence on active conflicts and gray zone operations is extensive.[144] Transformation of collected data into tactically and strategically useful intelligence faces obstacles despite DOD prioritization. DOD and federal funding levels and engagement suggest that some capabilities pioneered for the Services may be available for adaptation to SOF-peculiar needs. Existing intelligence tools use countries, regions, cities, and neighborhoods as the unit of analysis. This focus makes sense for general offense-defense cyber operations, cloning software, hacking tools, and trend-based intelligence production—instances where the precise geographic location of the target is less important. For SOF purposes, however, a disruptive innovation would aim to make the individual the unit of analysis. Future operations, those prior to FOE 2035, will require cloud-powered analysis of individuals within their cultural, political, linguistic, and social ecosystem based on internet-of-things activity and biometric measures in real time.

The national security implications of social media propaganda justify accelerating research funding across the DOD and federal government. Propaganda, broadly defined, influences elections, impacts violent extremist organization recruitment, and mobilizes society.[145] These propaganda efforts are taking on new forms and changing the dynamic of involvement in the affairs of others.[146] The shifting nature of propaganda activity simultaneously increases and decreases opportunities for SOF engagement. Social media's ubiquitous presence decreases barriers to entry of the information ecosystem. Yet, social media has degraded social trust in sources, suggesting that individuals assign trust and bias labels to messaging based on whether the message aligns with their belief system.[147] For SOF, offensive applications of social media capabilities—attempting to influence society and individuals—is based on individual or small group engagement. It will require different capabilities and requirements to analyze an individual's digital footprint to generate profiles in their holistic context.

Individualization of intelligence involves construction of political affinity-enmity profiles regarding a location's political regime or leader. Individualization not only identifies regime loyalty but generates probabilities of individual receptiveness to messaging. Existing psychology research suggests that political followers of a leader sort into five distinct groupings based on how they receive a regime's messaging.[148] One group, "Acolytes," blindly supports the regime. The regime's messaging reinforces their pre-existing views and their social identity, which is tied to the regime. In counterterrorism parlance, these are the hardliners who are highly resistant to engagement. The next two groups are regime conformers. "Lost Souls" are receptive to regime messaging because of a fragile sense of self, whereas "Authoritarians" are influenced by perceptions of regime legitimacy. Another conforming type is the "Bystander," which is an individual who accepts regime messaging because failure to do so may result in physical harm or social ostracism. Finally, "Opportunists" are those individuals who can process and potentially accept contrary messaging, enabling them to adopt different positions based on utilitarian calculations instead of emotions. Each follower type has distinct personality profiles. Other follower types, including those most critical to building effective partnerships, will require disruptive innovations in social media AI/ML to identify and engage in real time.

Network-centric individualized identification customizable to culture, language, region, and political regime requires neural network analysis of online behavior and interaction. The capacity of neural networks to cluster and classify data, combined with their ability to integrate algorithms with human coding and human perspectives, make them powerful tools for efficient identification of follower types. Disruptive innovations are unlikely to occur through hardware alone but instead through the combination of deep human understanding of society with cloud-based computational capacity.

Ultimately, intelligence analysis at the individual level is about establishing a probability of trust that can be actionably utilized. Trust is a social construct that is extraordinarily difficult to define, conceptualize, operationalize, and empirically test. Moreover, trust is contextualized by individual societies and changes over time.[149] USSOCOM's disparate experience across societies, cultures, and environments should be leveraged when pursuing disruptive innovation in social engagement technologies.

The application of social media-based follower type identification is applicable to the "by, with, and through" doctrine. The by, with, and through

collaborative model and SOF's extensive use and success in building foreign partnerships are predicated on engagement. Trust and cooperation are essential to timely success. Disruptive innovation in social media intelligence capabilities will speed societal engagement, relationship building, and threat assessment. Critically, application of social media disruptive innovations will augment currently limited civil affair capacity by enhancing operator social awareness and engagement.[150]

Acquisition and Procurement Opportunities

This section details potential acquisition and procurement actions to equip operators with a social media-based follower-type identification platform for individualized intelligence. The section examines the SOF-peculiar mission requirements detailed in a hypothetical scenario and identifies modes of public-private collaboration to develop such a capability. The conclusion examines how mainstream American norms and SOF values may affect development of AI/ML applications.

Integration of AI/ML applications will necessitate collaborative acquisition approaches. The most likely approaches involve the government serving as lead integrator and a joint interagency task force (JITF). USSOCOM has experience with both approaches, each having its own strengths and weaknesses. The hypothetical capability outlined in this example—cloud-based individualized intelligence analysis in real time—is a difficult technical problem because it requires extensive human input in sociopolitical conceptualizations of trust, assurance, and confidence, as well as other cultural and emotional components. The disruptive innovation of individualized intelligence delivery envisioned in this social media example is SOF-peculiar, at least initially. This is critical to the theoretical example because the capability is unlikely to be developed by the Services or other areas of the DOD, leaving SOF AT&L to acquire the capability.

The government-as-lead-integrator model is one viable approach to the acquisition of disruptive innovations. In this model, the government takes on the responsibility of managing and coordinating the program and ensuring that common standards are applied program wide. The government is responsible for supplying the technical expertise to create or integrate all aspects of the program. Because of the various technical capabilities required, the government-as-lead-integrator model assists in establishing

compatibility within the system-of-systems architecture needed to process vast amounts of social media and internet activity.

The government-as-lead-integrator approach's major strength is USSOCOM's experience from the TALOS program. TALOS demonstrated that system-of-systems integration is possible under government management as long as the technical problems associated with each component can be solved. Additional analysis, including detailed study of the TALOS program's history, is necessary to fully understand the degree to which technical or organizational limitations resulted in spinning out subsystems instead of a more complete working version of the TALOS suit. Consistent with organizational limitations arguments, the government-as-lead-integrator model raises important questions about the government's ability to recruit and retain the technical skills necessary for a complex project. The U.S. economy generally faces technical worker shortages across skill types, and it is unclear how these trends will translate into government personnel recruitment. [151]

The second acquisition approach is to establish a JITF to develop the capability. JITFs are not acquisition and procurement collaborations; instead, JITFs consolidate whole-of-government efforts to overcome a problem. The distinction in this case study requires transforming interagency collaborations into an effort where USSOCOM can acquire and procure the capability through establishing acquisition channels once the capability is developed with partner input. This represents a change from past JITFs in terms of leveraging the intelligence community and industry to develop the necessary capability under USSOCOM management.

USSOCOM's experience in Iraq provides the foundation for envisioning how to utilize a JITF to develop new technological capabilities. Task Force 714 transformed from a surgical capability to an intelligence-centric organization capable of capturing or killing on "an industrial scale."[152] Shultz and Clarke contend that partnerships with intelligence agencies—particularly the change from USSOCOM being solely a consumer of intelligence to becoming also a producer of intelligence—leveraged tools within the intelligence community that enabled the success of SOF operations.[153] The proposal in this case study is to extend the interagency collaboration by having USSOCOM handle any aspects necessary for the technical capability in-house through the acquisition and procurement process.

Partnerships with intelligence agencies would provide USSOCOM with access to the skills and technical capabilities necessary for follower-type

individualized intelligence. Consistent with the data advantages for Project Maven, USSOCOM's extensive, multi-source datasets provide unique algorithm training where socially constructed outcomes such as "trust" can be identified. Moreover, USSOCOM application of social media and internet-based analytical tools affords many "field to learn" experiences necessary for algorithm training. The collaboration with intelligence agencies would reduce the need for USSOCOM to build out the personnel necessary for capability development while ensuring end-user access for its warfighters.

A JIFT with intelligence agencies would further ensure that SOF values are integrated into the development of follower-type social media analysis methods. Development of disruptive innovations does not occur in a vacuum. AI/ML is frequently treated as a monolithic concept, thereby underplaying the importance of humans in the creation process. Development of follower-type analysis will require massive datasets spanning multiple cultures, languages, and societies. This effort will be based on—and will both reflect and be guided by—SOF values as well as mainstream U.S. norms and values more broadly. These norms and values are different from those underpinning and guiding the efforts of adversaries. For example, in the U.S. context, new technologies involving basic facial-recognition software will be shaped by domestic values and concerns about surveillance applications.[154] Roughly similar technologies developed elsewhere will be shaped by different values. In China, for example, massive domestic deployment of surveillance technology using facial-recognition software has not been controversial. Many experts argue that, as a result, the sophistication of Chinese facial-recognition technology will soon surpass that of the U.S. (if it has not already done so). The tension between democratic freedoms and the widespread use of facial-recognition tracking[155] has caused U.S. firms to reduce funding, end foreign firm relationships, and redirect R&D efforts.[156] The JIFT concept provides a potential bridge to overcome acquisition and procurement limitations by developing the capability through collaboration and engagement with the intelligence community (and those firms that provide support services).

This case study specifically focuses on SOF-peculiar disruptive innovation to highlight the role of USSOCOM in acquisition and procurement. Project Maven's full-motion video analysis has a DOD-wide application and will transition to Service budget lines at some point. Individualized, culturally informed intelligence is likely to remain a SOF-peculiar capability. SOF

insights into culture, society, language, and environment will be necessary for capability development. Human expertise is necessary to calibrate neural networks to the nuances of human society. Existing and future biometric scanning technologies extend beyond recognition and tracking to making inferences and predicting individual emotions and reactions. The goals of these technologies are to achieve tactical, real-time intelligence, such as the ability to differentiate between angry and hungry crowds.[157] Consistent with the history of SOF, humans are more important than hardware in establishing follower type and generating tactically useful biometric intelligence required for SOF-peculiar customization.

Summary and Implications

Disruptive innovation will take new and unimagined forms for SOF activities. SOF has a distinguished history in conducting and utilizing intelligence effectively, and the changing nature of societies necessitates continued adaptation. In many societies, from technologically advanced near peers to developing countries, the ability to operate clandestinely, undetected by technology or social media, is diminishing. Whether SOF presence goes mostly unnoticed or whether it is publicly announced, social media-based tools offer opportunities to support operations by emphasizing individual levels of analysis. Generation of real-time profiles based on biometric recognition and combined with internet-activity intelligence offers a disruptive innovation for SOF. The establishment of cooperative relationships, ultimately resulting in trust between operators and civilian populations, will remain a necessary feature for many core functions. Social media's encompassing capacity to track and document movements, beliefs, and contact networks, if leveraged effectively with AI/ML, provides an advantage for operators. The continuation of by, with, and through operations would benefit from the ability to analyze and sort crowds and individuals based on their threat risk and cooperation potential.

Conclusions

This monograph analyzes USSOCOM's ability to develop, integrate, and benefit from disruptive innovation in the SOF-peculiar context. Acquisition and utilization of disruptive innovations—technologies that categorically alter how SOF succeed in core activities through revolutionary change—are necessary to equip operators to win tomorrow's fight. The conceptualization of disruptive technology is applied to SOF-peculiar environments, noting important similarities and differences between SOF, DOD, and private-sector innovations. Relying on empirical data and interviews with SOF AT&L-K personnel, this research provides a general framework to engage current debates around policies and practices while recognizing the changing nature of international competition, SOF operational requirements, and accelerating technological change.

General conclusions include the following:

SOF AT&L-K's history of excellence relies on core SOF characteristics of flexibility, creativity, and adaptability. The overriding organizational imperative is delivery of capabilities to the warfighter. Organizational adaptability is reflected by creation of the PEO for SOF digital applications, utilization OTAs, and creation of the joint acquisition task force.[158] Specific policies such as monthly spending checks, systematic offloading of some contracting activities to the General Services Administration, and re-absorption of some contracting duties to ensure service delivery, are specific examples of organizational flexibility. Continual adjustment of policy, protocols, and organizations is now a constant in the rapidly changing operational environment.

The appropriate comparison category for disruptive innovations comprises near-peer adversaries. It is imperative that comparisons between SOF and the Services not be accepted as the benchmark for success in acquisition of disruptive innovation. Even as they highlight SOF strengths regarding both acquired capabilities and organizational capacity, such comparisons may incorrectly give the impression that revolutionary change is occurring when, in fact, evolutionary, incremental improvements are the norm. Near-peer comparisons will better position SOF

AT&L to achieve disruptive innovations in capabilities. Existing metrics used to compare acquisition organizations within the DOD (e.g., basic statistics on number of actions, dollars spent, DOD awards, etc.) fail to accurately capture performance. Development of new metrics and data analytics on performance are necessary to ensure organizational capability is properly evaluated.

A persistent difficulty is the definition of what it means for a requirement, capability, or condition to be "SOF-peculiar." The acquisition of general-purpose, non-SOF peculiar capabilities occurs and certainly improves organizational efficiency. At the same time, the lack of a general definition of SOF-peculiarity necessitates that USSOCOM step up to provide the capability, absorbing time and funding. Moreover, because a consistent definition of SOF-peculiarity is not available, it is difficult to estimate the consequences of this conceptual difficulty beyond qualitative identification.

Acronyms

AI	artificial intelligence
COIN	counterinsurgency
COTS	commercial off the shelf
DOD	Department of Defense
FAR	Federal Acquisition Regulation
FOE	future operating environment
GAO	Government Accountability Office
HEO	hyper-enabled operator
HQ	headquarters
IT	information technology
JITF	joint interagency task force
KO	contract officer
ML	machine learning
NDA	non-disclosure agreement
OTA	other transaction authorities
P2P	procure-to-pay
PEO	Program Executive Office
PPP	public-private partnership
R&D	research and development
SOF	Special Operations Forces
SOF AT&L	Special Operations Forces Acquisition, Technology, and Logistics

SOF AT&L-K	Special Operations Forces Acquisition, Technology, Logistics, and Contracting
SOFIC	Special Operations Forces Industry Conference
TALOS	Tactical Assault Light Operator Suit
TRL	technology readiness level
TSOC	Theatre Special Operations Command
USSOCOM	U.S. Special Operations Command

Endnotes

1. White House, *National Security Strategy of the United States of America* (Washington, D.C.: White House, 2017), https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf.
2. The DOD's conceptualization of acquisition is used: "[t]he conceptualization, initiation, design, development, test, contracting, production, deployment, integrated product support (IPS), modification, and disposal of weapons and other systems, supplies, or services (including construction) to satisfy DOD needs, intended for use in, or in support of, military missions." "Life Cycle Logistical (LCL) Functional Area," *Defense Acquisition University*, accessed 30 December 2017, https://www.dau.edu/acquipedia/pages/ArticleContent.aspx?itemid=423. Note that acquisition includes not only procurement but also product support, modification, and disposal of weapon systems as well as the acquisition of other systems, goods, and services. Thus, for this study, the term acquisition will cover all these activities. We utilize procurement as outlined by Philip S. Anton et al., *Baselining Defense Acquisition* (Santa Monica: RAND Corporation, 2019): 1. Lisa Smith, USSOCOM's science and technology director, stated that "SOCOM needs to work through some policy questions as it develops [artificial intelligence]. In some cases, it could take 10 years for capabilities to get approved," in Sydney J. Freedberg, Jr., "Artificial Intelligence: Will Special Operators Lead the Way?" *Breakingdefense.com*, accessed 13 February 2019, https://breakingdefense.com/2019/02/artificial-intelligence-will-special-operators-lead-the-way/. Even in areas of developed technologies, specifically unmanned aerial systems, advancing technology threatens the functionality of existing technology, which will require alterations so that technological capabilities can be fielded and services maintained. See John Harper, "Special Operations Drones Face Obsolescence," *National Defense*, 17 May 2017, https://www.realcleardefense.com/2017/05/17/special_operations_drones_face_obsolescence_293160.html.
3. See Sarah O'Meara, "Will China Overtake the U.S. in Artificial Intelligence Research? The Nation Wants to Make Its AI Industry Dominant by 2030," *Nature Magazine*, 24 August 2019, https://www.scientificamerican.com/article/will-china-overtake-the-u-s-in-artificial-intelligence-research/. Inconsistent budgeting affects acquisition and procurement in two ways. First, the total budget amount effects program decision, allotments, and force planning. Second, how Congress appropriates the funds, either through normal budgetary process or continuing resolutions, affects procurement decisions, management, and planning. Continuing resolutions are generally thought to be less efficient in weapons procurement because of decision delays and different budgetary rules. A RAND study of DOD weapons systems during fiscal years 2013 and 2015 found that some unit costs actually decreased during that time. The small sample, however, limits confirmation that continuing resolutions do not disrupt procurement. Alternatively, the Congressional Research Service found that 75 weapons programs were delayed

by the fiscal year 2018 continuing resolutions prohibition on new starts, and 40 programs were affected by production limitations. See Stephanie Young and J. Michael Gilmore, *Operating Under a Continuing Resolution: A Limited Assessment of Effects of Defense Procurement Contract Awards* (Santa Monica: RAND Corporation, 2019); *Defense Spending Under an Interim Continuing Resolution: In Brief*, CRS Report No. R45870 (Washington, D.C.: Congressional Research Service, 2019), https://sgp.fas.org/crs/natsec/R45870.pdf. For review of gaps in U.S. AI policy, see Michael Horowitz et al., *Strategic Competition in an Era of Artificial Intelligence* (Washington, D.C.: Center for a New American Security, 2020), https://www.cnas.org/publications/reports/strategic-competition-in-an-era-of-artificial-intelligence; Michael Horowitz and Lauren Kahn, "The AI Literacy Gap Hobbling American Officialdom," *War on the Rocks*, January 2020, https://warontherocks.com/2020/01/the-ai-literacy-gap-hobbling-american-officialdom/.

4. Disruption innovation and military innovation are distinct concepts. In my framework, disruption requires paradigm shifts and new outcome measures. What constitutes military innovation is a hotly contested topic. For a review of the literature, see Stuart Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?" *Journal of Strategic Studies* 40, no. 1–2 (2017): 217–218; Adam Grissom, "The Future of Military Innovation Studies," J*ournal of Strategic Studies* 29, no. 5 (2020): 905–934. The most thorough contemporary examination of military innovation is conducted by Michael C. Horowitz and Shira E. Pindyck, "What is Military Innovation? A Proposed Framework," *SSRN*, 23 December 2019, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3504246. They evaluated 73 political science and history texts on innovation and identified several common themes that are integrated into their framework. The innovation process begins with invention, incubation, and political will to implement. While this framework is similar to the one I develop, two distinctions are worth noting. First, their incubation stage is the process by which an innovation "gains status and influence through both top-down and bottom-up processes." This is the phase most consistent with economic feasibility in my framework. Economic imperatives, including the capacity to manufacture or produce a product is as necessary as acceptance of military command to utilize it. Acquisition activities further elevate the importance of commercial viability. Second, political will occurs at multiple phases of the development process in my framework, particularly in initial phases of the process. USSOCOM is not a passive actor in the innovative cycle. Operator-driven requirements are essential in the development of disruptive innovations. Third, effective policies to utilize the disruptive innovation must occur. Policy is broadly defined to include military doctrine and acquisition process to actually field it. In both this manuscript and Horowitz's and Pindyck's "What is Military Innovation?" success on the battlefield is not a necessary condition for innovation because battlefield success is too broad and idiosyncratic a metric by which to evaluate innovation.

5. The importance of unit cost and overall costs will determine procurement policies. The DOD's economic feasibility is distinct from market-based definitions as the DOD is an oligarchic buyer that influences prices and demand. In

USSOCOM's situation, functional prototypes that pass reliability benchmarks would be considered economically feasible even if unit costs are substantially higher than the inflection point for commercial applications. For example, consider quantum computing. It is potentially a disruptive innovation as it revolutionizes size, energy demands, and computational power. Quantum computing has not yet occurred as quantum computers are not yet available commercially. Their nascent development does not preclude quantum computers' utilization to power new discoveries based on their capacity, but the technology is not yet a truly disruptive innovation. Google demonstrated the potential of quantum computing, though a commercial application may still be years away. See Cade Metz, "Google Claims a Quantum Breakthrough That Could Change Computing," *New York Times*, 23 October 2019, https://www.nytimes.com/2019/10/23/technology/quantum-computing-google.html.

6. Economic feasibility for USSOCOM means that the total cost (e.g., human hours, financial, bureaucratic, etc.) of the disruptive innovation is less than the strategic, operational, and tactical benefits. This is not as simple a profitability calculation as it would be in the private sector. Calculating the benefits of the application of a nascent capability in a future environment is exceedingly difficult. Similarly, conceptualizing and operationalizing benefits is challenging. Despite the difficulty, development of processes for determining the economic feasibility that adequately encompasses challenges such as small scale, budget limitations (amounts and planning horizons), adhering to the FAR, time to operator, and standards-based design versus private sector intellectual property are necessary for innovation to occur. Evaluation of USSOCOM's organizational advantages of small size, culture, higher risk tolerance, and shorter decision chains also contribute to financial feasibility.

7. Colonel Joe Capobianco and Colonel David Phillips, "Strengths and Myths of What Makes Special Operations Forces Acquisition Special," *Army ATL Magazine*, 14 May 2018, https://asc.army.mil/web/news-alt-jas18-strengths-and-myths-of-what-makes-special-operations-forces-acquisition-special/.

8. Sydney J. Freedberg, "SOCOM Builds Iron Man, Piece by Piece," *Breaking Defense*, 29 January 2015, https://breakingdefense.com/2015/01/socom-builds-iron-man-piece-by-piece/.

9. The ambitious TALOS program did not deliver on its 2018 deadline and did not reach levels of suit-wide interconnectivity, although sub-systems will continue to be redefined. Importantly for future technologies, the government-as-lead-integrator model demonstrated organizational weaknesses that may impede similar programs. This innovative approach to acquisition and procurement was the unique bureaucratic structure of TALOS, and its limitations suggest USSOCOM will continue to rely on industry to act as lead integrator. The implications for future disruptive technology of this failure is that industry will continue to shape technology availability. Contentious issues such as intellectual property rights will likely continue. For a review of TALOS, see Jared Keller, "SOCOM's Iron Man Suit Is Officially Dead," *Task & Purpose*, 15 February 2019, https://taskandpurpose.

com/military-tech/talos-iron-man-suit-dead; Patrick Tucker, "SOCOM's Much-Anticipated Super Suit Won't Be Here for Christmas," *Defense One*, February 2019, https://www.defenseone.com/technology/2019/02/us-military-chopping-its-iron-man-suit-parts/154706/. For an analysis of TALOS with government as lead operator, see Benjamin Tkach, *Special Operations Command Contracting: 21st Century Approaches for Service and Technology Acquisition* (Tampa: JSOU Press, 2017).

10. SOF AT&L-K has several organizational advantages in pursuing disruptive innovation. The creation of SOFWERX, for example, demonstrates political will to pursue policy changes and create capabilities that maximize procurement authorities. Second, an advantage of SOF AT&L-K is its smaller financial totals compared to the Services. The majority of procurement activity is at acquisition category 2 and 3 levels. These lower levels have different reporting, regulation, and decision milestone processes. Thus, while SOF AT&L-K complies with all FAR, direct comparisons between the Services and USSOCOM on procurement are only meaningful when consistency of program size is incorporated into the analysis. Indeed, the most recent (and severely dated) analysis of USSOCOM management of weapons system programs by the Congressional Budget Office found that USSOCOM performance was mixed. The programs that were most likely to experience problems were the more expensive programs (acquisition categories 1 and 2). At the time of the report, 88 percent of all programs were acquisition category 3. Despite the dated results, the implication is that program complexity may affect management effectiveness. *Defense Acquisition: An Analysis of the Special Operations Command's Management of Weapon System Programs*, GAO-07-620 (Washington, D.C.: Government Accountability Office, 2007). For an overview of potential problems in acquisition category 2 and 3 programs, see *Audit of the Services Acquisition Executive's Management of Defense Acquisition Category 2 and 3 Program* (Washington, D.C.: Department of Defense, 2020).
11. Terry Pierce, *Warfighting and Disruptive Technology: Disguising Innovation* (Oxon: Frank and Case, 2006).
12. As recently as 2017, General Thomas stated that primitive drones were able to interrupt USSOCOM operations against ISIS. Enemies that can leverage disruptive technologies can deny or degrade U.S. operational capability. See James Long, "Disruptive Innovation Win Wars: Here's How the Army Can Get Better at It" (Modern War Institute at West Point, 2019), https://mwi.usma.edu/disruptive-innovation-wins-wars-heres-army-can-get-better/. Policy makers increasingly utilize SOF because of their clandestine nature, lethality, and small footprint. However, frequently pressing the "easy button" on policy alternatives may undermine regional and international security order. See Russell A. Burgos, "Pushing the Easy Button: Special Operations Forces, International Security and the Use of Force," *Special Operations Journal* 4, no. 2 (2018): 109–128.
13. Dan Yu and Chang Chieh Hang, "Creating Technology Candidates for Disruptive Innovations, Generally Applicable R&D Strategies," *Technovation* 31, no. 2 (2011): 401–440; Riccardo Vecchiato, "Disruptive Innovations, Managerial Cognition,

and Technology Competition Outcomes," *Technological Forecasting and Social Change* 116 (2017): 116–128.

14. Research specific to SOF acquisition and procurement practices is limited. For an initial examination, see Tkach, *Special Operations Command Contracting*. For a brief overview of SOF AT&L and its features, see Capobianco and Phillips, "Strengths and Myths."
15. Jani Saastamoinen, Helen Reijonen, and Timo Tammi, "Should SMEs Pursue Public Procurement to Improve Innovative Performance?" *Technovation* 69 (2018): 2–14; Uyarra Elvira et al., "Public Procurement, Innovation and Industrial Policy: Rationales, Roles, Capabilities, and Implementation," *Research Policy* 49, no. 1 (2020).
16. For example, China's ability to coop business for national security priorities is an organizational advantage that is not an option in the United States. See Gregory C. Allen, "Understanding China's AI Strategy: Clues to Chinese Strategic Thinking on Artificial Intelligence and National Security," *Center for New American Security*, 6 February 2019, https://www.cnas.org/publications/reports/understanding-chinas-ai-strategy.
17. Quoted in Vivienne Machi, "Special Operations Command Needs New Tech to Take on Russia, China," *National Defense*, May 2018, https://www.nationaldefensemagazine.org/articles/2018/5/22/socom-seeking-industry-collaboration-on-new-tech-to-combat-nearpeer-adversaries.
18. Kyel Rempfer, "SOCOM Needs to Step Up Its Propaganda Game, Pentagon Deputy Says," *Military Times*, February 2019, https://www.militarytimes.com/news/your-military/2019/02/06/socom-needs-to-step-up-its-propaganda-game-pentagon-deputy-says/.
19. C. N. Thoroughgood et al., "The Susceptible Circle: A Taxonomy of Followers Associated with Destructive Leadership," *The Leadership Quarterly* 23, no. 5 (2012): 897–917.
20. AI is perhaps a less understood yet widely desired technical innovation in the DOD. General understanding of AI in the DOD is limited but remains a policy issue on par with technology development. See Micheal Horowitz and Casey Mahoney, "Artificial Intelligence and the Military: Technology Is Only Half the Battle," *War On the Rocks*, 25 December 2018, https://warontherocks.com/2018/12/artificial-intelligence-and-the-military-technology-is-only-half-the-battle/. Lieutenant Commander Kreps describes procurement personnel understanding of AI with the following passage: "While the interviewees were not always clear about what artificial intelligence is, the technology could be helpful for procurement in market research, negotiations, insight, and contract management, among other ways." See Kory Kreps, "How Can DOD Adopt Commercial-Style Artificial Intelligence for Procurement?" NPS-CM-20-152 (Monterey: Naval Post Graduate School, 2020), https://dair.nps.edu/handle/123456789/4159.
21. Even when facing numerical inferiority from the Soviets, the U.S. devised the First Offset strategy of nuclear capability to ensure competitive advantages. This

first strategy evolved into the Second Offset (precision strike and sensor penetration) and the current Third Offset strategy emphasis on integration of "smart" systems in the Joint Force.

22. See General Charles F. Wald and Ted Johnson, "Here, There, and Everywhere: The Key Military Competitive Advantage Is Omnipresence," *Deloitte Insights*, 11 May 2017, https://www2.deloitte.com/us/en/insights/industry/public-sector/omnipresence-key-to-us-military-strategy.html.
23. Ian Livingston, "Technology and the 'Third Offset' Foster Innovation for the Force of the Future," *Brookings Institute*, December 2016, https://www.brookings.edu/blog/order-from-chaos/2016/12/09/technology-and-the-third-offset-foster-innovation-for-the-force-of-the-future/.
24. There is not agreement on the degree to which U.S. military competitive advantage in great power competition is eroding. In general, agreement exists that China and Russia are increasingly able to challenge the U.S. or will be able to in the near future. At one end of the continuum of competitive advantage are those that contend the U.S. and NATO members have already lost the competitive advantage and will face significant challenges to defeat Russia or China if conflict breaks out. See Chairman of the Joint Chiefs of Staff General Dunford's comments on NATO's new strategy due to erosion of capability in David Brennan, "NATO Superiority Over Russia Has 'Eroded', Forcing Alliance to Create New Strategy, U.S. General Says," *Newsweek*, 18 September 2019. The U.S. National Defense Strategy Commission, a bi-partisan commission reviewing U.S. defense policy, also concluded U.S. competitive advantages versus near peers is eroding. See Eric Edelman and Gary Roughead, *Common Defense: The Assessment and Recommendations of the National Defense Strategy Commission* (Washington, D.C.: U.S. Printing Office, 2018).
25. The total share of U.S. R&D accounts for approximately 25 percent of global totals, down from 37 percent in 2000. "Research and Development: U.S. Treands and International Comparisons," *Science and Engineering Indicators* (Alexandria: National Science Foundation, 2018): 33–41, https://nsf.gov/statistics/2018/nsb20181/assets/1038/research-and-development-u-s-trends-and-international-comparisons.pdf. U.S. federal R&D spending as a percent of gross domestic product peaked in 1965 and has since declined. See Caleb Foote and Robert D. Atkinson, "Dwindling Federal Support for R&D Is a Recipe for Economic and Strategic Decline," *Information Technology and Innovation Foundation*, 14 December 2018, https://itif.org/publications/2018/12/14/dwindling-federal-support-rd-recipe-economic-and-strategic-decline.
26. Graham Allison, "Is China Beating the U.S. to AI Supremacy?" *The National Interest*, 22 December 2019, https://nationalinterest.org/feature/china-beating-america-ai-supremacy-106861.
27. Luc Dunn, "Sustainment Is Unique 'Army Competitive Advantage' Association of the United States Army," *Association of the United States Army*, 30 July 2015, https://www.ausa.org/articles/sustainment-unique-'army-competitive-advantage'.

28. White House, *National Security Strategy of The United States of America* (Washington, D.C.: White House, 2017): 2, https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf; Michael Mandelbaum, *Mission Failure: American and the World in the Post-Cold War Era* (New York: Oxford University Press, 2016).
29. Miranda Priebe et al., *Distributed Operations in a Contested Environment: Implications of USAF Force Presentation* (Santa Monica: The RAND Corporation, 2019); "Joint Warfighting Concept Assumes 'Contested Logistics,'" *Defense Daily*, 6 October 2020, https://www.defensedaily.com/joint-warfighting-concept-assumes-contested-logistics/pentagon/.
30. Claire Graja, "SOF and the Future of Global Competition," *Center for Stability and Development*, May 2019, https://www.cna.org/CNA_files/PDF/DCP-2019-U-020033-Final.pdf; Jim Thomas and Chris Dougherty, *Beyond the Ramparts: The Future of U.S. Special Operations Forces* (Center for Strategic and Budgetary Assessments, Washington, D.C.: CSBA, 2013): 3.
31. *Statement of General Joseph L. Votel, U.S. Army Commander United States Special Operations Command before the House Armed Services Committee, Subcommittee on Emerging Threats and Capabilities*, 18 March 2015, https://docs.house.gov/meetings/AS/AS26/20150318/103157/HMTG-114-AS26-Wstate-VotelUSAJ-20150318.pdf.
32. Eitan Shamir and Eyal Ben-Ari, "The Rise of Special Operations Forces: Generalized Specialization, Boundary Spanning and Military Autonomy," *Journal of Strategic Studies* 41, no. 3 (2018): 335–371.
33. William H. McRaven, "The Theory of Special Operations" (Monterey: Naval Post Graduate School, 1993).
34. David Barno and Nora Benshahel, "Fighting and Winning in the 'Gray Zone,'" *War on the Rocks*, 19 May 2015, https://warontherocks.com/2015/05/fighting-and-winning-in-the-gray-zone/.
35. There is significant debate on the importance of developing a SOF theory. The importance of theory is to educate and "inform decision making, doctrine, and operations." See Harry Yager, "Two Special Operations/SOF Theory Challenges: Building Depth and Avoiding Prescriptions," in *Special Operations Theory*, Peter McCabe and Paul Lieber, eds. (Tampa: JSOU Press, 2017): 165. Proponents of developing a theory argue that such a theory can help identify when and how to best utilize the Force. Moreover, a clear theoretical understanding of SOF from a social science perspective allows for comparative analysis of operational outcomes cross-nationally and over time. Antagonists to the idea of constructing a SOF theory argue that a new theory of war is not necessary to correctly place SOF within multiple contexts. Moreover, lack of information, credibility, and institutional impediments may generate a theory without application and actually detract from understanding of SOF. For a negative argument, see James Kiras, "A Theory of Special Operations: 'These Ideas Are Dangerous,'" *Special Operations Journal* 1, no. 2 (2015): 75–88. Initial development of a SOF theory can be found

in Alastir Finlan, "A Dangerous Pathway? Toward a Theory of Special Forces," *Comparative Strategy* 39, no. 4 (2019): 255–275; William H. McRaven, *Spec Ops: Case Studies in Special Operations Warfare: Theory and Practice* (Novato: Presidio Press, 1995); Robert G. Spula, Jr., *A Theory of Special Operations: The Origins, Qualities, and Use of SOF* (Tampa: JSOU Press, 2017).

36. "Disruptive innovations offer new performance metrics while sustaining innovations offer improvements along previously established performance trajectories." Peter Dombrowski and Eugene Gholz, *Buying Military Transformation: Technological Innovation in the Defense Industry* (New York: Columbia University Press, 2006).

37. Matt Marx, Joshua S. Gans, and David H. Hsu, "Dynamic Commercialization Strategies for Disruptive Technologies: Evidence from Speech Recognition Industry," *Management Science* 60, no. 112 (2014): 3103–3123.

38. The value proposition is sufficiently unique that innovators may briefly enter the marketplace to identify the value of the disruption and avenues for financial investment. Technology commercialization strategies are frequently used by start-ups to gauge the interest and opportunities to finance product development. For example, companies in the speech recognition industry are advantaged when they temporarily integrate commercially to establish the value of their product before establishing a cooperative licensing model. Thus, in speech recognition, an area of need identified by USSOCOM, engagement with firms at the initial market entrant is the first opportunity to acquire and procure disruptive innovation. Failure to identify these opportunities further extends the likelihood of incremental instead of revolutionary change as firms exit the market to reevaluate their technology and business models. For a discussion on the speech recognition industry, see Matt Marx and David H. Hsu, *Technology Commercialization Strategy Dynamics and Entrepreneurial Performance: Evidence from Speech Recognition Industry*, 2013, https://www.rotman.utoronto.ca/-/media/Files/Programs-and-Areas/Strategy/papers/TechCommercializationStrat%20Dynamics.pdf.

39. See Horowitz and Pindyck, "What is Military Innovation?," 17. They define military innovation as "changes in the conduct of warfare designed to increase the ability of a military organization to convert the components of potential military power into actual military power." This more inclusive definition implicitly incorporates economic feasibility through the translation of capability to military power.

40. For discussion of Navy and Marine innovations, see Terry C. Pierce, *Warfighting and Disruptive Technologies: Disguising Innovations* (New York: Routledge, 2005). For discussion of population-based COIN innovations, see Horowitz and Pindyck, "What is Military Innovation?"

41. Helicopter warfare did not result in strategic victory in Vietnam, and population-based COIN did not transform Afghanistan. In both instances, battlefield success and strategic success required additional inputs beyond the disruptive innovation. Carrier battlegroups did result in strategic success in the Pacific theater in

World War II. Carrier battlegroups also demonstrate that adversaries can deploy innovation first and still lose a conflict.

42. The following quote summarizes the inconsistent use of the term disruption: "In our experience, too many people who speak of 'disruption' have not read a serious book or article on the subject. Too frequently, they use the term loosely to invoke the concept of innovation in support of whatever it is they wish to do." Clayton M. Christensen, Michael E. Raynor, and Rory McDonald, "What is Disruptive Innovation?" *Harvard Business Review*, December, 2015, https://hbr.org/2015/12/what-is-disruptive-innovation.
43. Joseph L. Bower and Clayton M. Christensen, "Disruptive Technologies: Catching the Wave," *Harvard Business Review*, January–February 1995, 43–53; Christensen, Raynor, and McDonald, "What is Disruptive Innovation?"
44. Christensen, Raynor, and McDonald, "What is Disruptive Innovation?"
45. The following quote identifies the importance of profitability: "Specifically, as incumbents focus on improving their products and services for their most demanding (and usually most profitable) customers, they exceed the needs of some segments and ignore the needs of others. Entrants that prove disruptive begin by successfully targeting those overlooked segments, gaining a foothold by delivering more-suitable functionality— frequently at a lower price." Christensen, Raynor, and McDonald, "What is Disruptive Innovation?"
46. Christensen describes this process as developing new market footholds which occur when "disrupters create a market where none existed. Put simply, they find a way to turn non-consumers into consumers." Christensen, Raynor, and McDonald, "What is Disruptive Innovation?"
47. Alteration of organizational norms is encapsulated by Lieutenant Colonel Tlapa's comment on the importance of disruption. He states that "the U.S. military must be willing to question and change its organizational culture to foster innovation, to recognize external and internal changes, discern how those changes can be adapted, and experiment with ideas and promulgate those that survive. If unable to do this, United States and its military may await spectacular surprise." Jeff Tlapa, "Disrupt or Be Disrupted," *U.S. Naval Institute*, August 2016, https://www.usni.org/magazines/proceedings/2016/august/disrupt-or-be-disrupted.
48. Incremental improvements under some circumstances may exhibit disruptive characteristics due to the convergence of technology. The convergence of technology, however, lacks strategic planning and only rarely emerges. See Fredrik Hacklin, V. Raurich, and Christian Marxt, "How Incremental Innovation Becomes Disruptive: The Case of Technology Convergence," *IEEE*, 21 October 2004, https://ieeexplore.ieee.org/abstract/document/1407070.
49. Joe Miller and Monte Erfourth, "SOF in Competition: Establishing the Foundation of Strategy," *Small Wars Journal* 1, no. 3 (2019), https://smallwarsjournal.com/jrnl/art/sof-competition-establishing-foundation-strategy-v13.
50. Constantinos Markides, "Disruptive Innovation: In Need of Better Theory," *Journal of Product Innovation Management* 23, no. 1 (2005): 19–25.

51. Clayton Christensen, "Disruptive Innovation," *claytonchristensen.com*, accessed 28 October 2022, http://claytonchristensen.com/key-concepts/.
52. Requirement generation and fulfilment from organizations such as SOFWERX have progressed from early identification of technical problems (e.g., missiles on boats, hand grips, etc.) to requirements more consistent with disruptive innovations (e.g., the seeing through walls event). Yet, existing SOFWERX unclassified delivery of capabilities remains evolutionary. Tracking and analysis of more ambitious disruptive innovations from SOFWERX is necessary before determining the organizations contribution to disruptive innovation.
53. The delivery of capabilities to operators based on the good will of suppliers is also representative of the tension between force sustainment and R&D investment. SOF AT&L's priority is and should be on the existing mission. Interview conducted by the author at MacDill AFB, June 2019 under Mississippi State University Institutional Review Board-19-231.
54. For an extensive discussion of military officer focus on difficulties in implementing and sustaining disruptive innovation, see Terry Pierce, *Warfighting and Disruptive Technology: Disguising Innovation* (Oxon: Frank and Case, 2006).
55. Horowitz's adoption-capacity theory argues that financial intensity (per-unit cost) and organizational capital (capacity of an organization to implement new policy) determines when an innovation is adopted. The higher per-unit cost restricts some innovations to state actors while organization adaptation is an advantage of nimble (smaller) organizations. Michael Horowitz, *The Diffusion of Military Power: Causes and Consequences for International Politics* (Princeton: Princeton University Press, 2010).
56. For contemporary discussions on risk aversion in the military, see Ben Summers, "Slow, Inflexible, and Micro-managed: The Problems of a Military that Overstates Risk," *Modern Institute of War at West Point*, May 2017, https://mwi.usma.edu/slow-inflexible-micromanaged-problems-military-overstates-risk/. One analyst describes the Army's risk aversion behavior as a form of helicopter parenting. See Major Lynn Marie Breckenridge, "Curbing the 'Helicopter Commander': Overcoming Risk Aversion and Fostering Discipline Initiative in the U.S. Army," *Military Review*, July-August 2017, https://www.armyupress.army.mil/Portals/7/military-review/Archives/English/MilitaryReview_20170831_BRECKENRIDGE_Helicopter_Commander.pdf.
57. Preston Cline, *Risk Management for U.S. Army Special Operation: Addressing the Need to Continuously Adapt to a Changing Problem Set* (Philadelphia: Mission Critical Team Institute, 2013).
58. For a discussion on innovation in AI, see Horowitz and Kahn, "The AI Literacy Gap".
59. T. S. Walsh, B.A. Kirchoff, and S. Newbert, "Differentiating Market Strategies for Disruptive Innovation," *IEEE Transactions on Engineering Management* 49, no. 4 (2002): 341–351.

60. Charles W. Mahoney, "Buyer Beware: How Market Structure Affects Contracting and Company Performance in the Private Military Industry," *Security Studies* 26, no. 1 (2017): 30–59.
61. Dombrowski and Gholz, *Buying Military Transformation*.
62. Dombrowski and Gholz, *Buying Military Transformation*, 534.
63. One prominent example is Charles Schwab's expansion into online trading after rivals. Charles Schwab's adaptation may have been aided by its past experience of disruption of establishing discount brokerage, disrupting existing incumbent Merrill Lynch. See Erwin Dannells, "Disruptive Technology Reconsidered: A Critique and Research Agenda," *Journal of Production Innovation Management* 21 (2004): 246–258.
64. Charles W. Mahoney, "Acquire or Expire: Publicly Traded Defense Contractors, Financial Markets, and Consolidation in the U.S. Defense Industry," *Defense and Peace Economics* 32, no. 3 (2021): 325–342.
65. This section is not attempting to generate a holistic understanding of FOE 2035 or USSOCOM's operational contexts. Instead, it focuses on the challenges of FOE 2035 in acquisition.
66. Erik Gartzke, "Blood and Robots: How Remotely Piloted Vehicles and Related Technologies Will Affect the Politics of Violence," *Journal of Strategic Studies* 44, no. 7 (2019): 983–1013, https://doi.org/10.1080/01402390.2019.1643329.
67. Ian Livingston, "Technology and the 'Third Offset' Foster Innovation for the Force of the Future," *Brookings Institute*, 9 December 2016, https://www.brookings.edu/blog/order-from-chaos/2016/12/09/technology-and-the-third-offset-foster-innovation-for-the-force-of-the-future/#cancel.
68. Chris Balcik, "Military Tactical Communications Meets the New Hyper-Enabled Operator," *Insights*, 5 June 2019, https://insights.samsung.com/2019/06/05/military-tactical-communications-meets-the-new-hyper-enabled-operator/.
69. Jared Keller, "Inside SOCOM's Effort to Build a 'Hyper-Enabled Operator' Who Can Outsmart the Enemy at Every Turn," *Task & Purpose*, 19 December 2019, https://taskandpurpose.com/military-tech/hyper-enabled-operator-socom.
70. This section is aligned with the recent comments of USSOCOM's JATF-HEO director, Colonel Russell. I intentionally highlight the importance of challenging the SOF Truth as disruptive innovation, compared to incremental changes envisioned in HEO, necessitates total review of processes. In a recent interview, Colonel Russell stated that "One thing to remember is that humans are more important than hardware. We're providing tools to enable and assist the operator, but at the center of that is [so] operators who are well-trained, mature adults who have to make decisions on the battlefield. A great kit that's never turned on is just a waste and dead weight." Keller, "Inside SOCOM's Effort."
71. Alex MacCalman et al., "The Hyper-Enabled Operator," *Small Wars Journal*, 6 June 2019, https://smallwarsjournal.com/jrnl/art/hyper-enabled-operator.

72. Tammy Low, *Exploitation of Big Data for Special Operations Forces* (Tampa: JSOU Press, 2018).
73. "U.S. Special Operations Command (SOCOM) Explores Artificial Intelligence (AI) for the Future Battlefield," *Military Aerospace and Electronics*, August 2019, https://www.militaryaerospace.com/computers/article/14038269/artificial-intelligence-ai-special-operations.
74. The effectiveness of programs designed to improve language ability and cultural awareness often rely on self-reported metrics. Self-reported results are acceptable but lack the rigor of external validation. For example, Surface, Ward, and Associates' evaluation of USSOCOM's Special Operations Language Training Software relies on self-reporting where learning language content is explicitly not part of the metric. Evaluation metrics were not rigorous and should have measured areas such as what the trainee learned, what the trainee's view of the training was, and what type of training is more or less effective. AI-enabled language translation will provide real-time conversational level engagement, a substantial improvement over current methods. For a review of the USSOCOM language training in Iraq, see Eric Surface, Erich C. Dierdorff, and Arron Watson, "Special Operations Language Training Software Measurement Effectiveness Study: Tactical Iraqi Study Final Report," *Central Army Registry*, 20 November 2008, https://rdl.train.army.mil/catalog-ws/view/100.ATSC/56F12B52-936B-4B85-A11D-44D3F590E2DF-1274550929321/BCKStest/ussocom_tactical_iraqi_study_final_report_swa_20070501.pdf.
75. Bavid Barno and Nora Bensahel, "How to Fix U.S. Special Operations Forces," *War on the Rocks*, 25 February 2020, https://warontherocks.com/2020/02/how-to-fix-u-s-special-operations-forces/; *U.S. Special Operations Forces (SOF): Background and Issues for Congress*, RS21048 (Washington, D.C.: Congressional Research Service, 2020): 8, https://fas.org/sgp/crs/natsec/RS21048.pdf; "Congress Questions Whether U.S. Special Operations Forces Should Remain in High Demand," *All Things Considered*, 7 May 2019, https://www.npr.org/2019/05/07/721172237/congress-questions-whether-u-s-special-operations-forces-should-remain-in-high-d.
76. Statement of General Joseph L. Votel.
77. United States Army Special Operations Command, *"Little Green Men:" A Primer on Modern Russian Unconventional Warfare, Ukraine 2013–2014* (Fort Bragg: U.S. Army Special Operations Command, 2016).
78. Carson Austin, *Secret Wars: Covert Conflict in International Politics* (Princeton: Princeton University Press, 2018).
79. Carson succinctly summarizes his theory this way: "My theory focuses on two specific escalation problems: constraints created by domestic hawks and misunderstandings among adversaries about the value of limited war. My theory claims that backstaging military interventions allows rival leaders to insulate themselves and one another from domestic hawkish constraints. In addition, embracing the backstage communicates shared interest in keeping war limited. This basic relationship provides a unifying logic for initial decision to intervene

covertly, a detector's decision to collude after detection, and an intervener's continuing non-acknowledgment of a widely exposed intervention." Carson, *Secret Wars*, 10. Additional rational for not exposing adversary gray zone activity includes protection of sources, protection of foreign regimes, and enable future operations.

80. Carson, *Secret Wars*, 13.

81. Havard Herge et al., "ViEWS: A Political Violence Early-Warning System," *Journal of Peace Research* 56, no. 2 (2019): 155–174.

82. Stew Magnuson, "NEW from SO/LIC: 'Iron Man' Suit to Fall Short of Its Goals," *National Defense*, 6 February 2019, https://www.nationaldefensemagazine.org/articles/2019/2/6/special-ops-iron-man-suit.

83. This argument is content on the assumption that SOF are operationally distinct from the Services. If, in fact, SOF are not unique in an operational context, this point does not apply.

84. Comments taken from interviews on the War on the Rocks podcast, David Barno et al., "Change or Die," *War on the Rocks*, 10 November 2020, https://warontherocks.com/2020/11/change-or-die/.

85. Colonel Obergfell-provided data through June 2019 enables comparisons with DOD. It includes actions, dollars, and vacancies.

86. Direct comparisons between USSOCOM and the Services is frequently inappropriate due to the difference in scale and regulation associated with different acquisition category levels. The majority of USSOCOM funding is acquisition category 3 levels, which has different FAR regulations than acquisition category 1 programs. Those frequently have the most acquisition problems due to size and complexity. The GAO's review of USSOCOM's management of weapons systems programs found mixed results even though the majority (88 percent) of spending occurs at the acquisition category 3 level, which is the least complex and typically utilizes COSTS. The report is extremely dated, published in 2007, and numerous reorganizations have occurred since, but the report enables direct comparisons with the Services. See *Defense Acquisitions: An Analysis of Special Operations Command's Management of Weapon System Program*, GAO-07-620 (Washington, D.C.: Government Accountability Office, 2007), https://www.gao.gov/products/gao-07-620. For the GAO, the DOD may not even provide enough information on acquisition category 2 and 3 levels to perform evaluations, further reducing comparisons with USSOCOM performance. See *Defense Acquisitions: Better Approach Needed to Account for Number, Cost, and Performance of Non-Major Programs*, GAO-15-188 (Washington, D.C.: Government Accountability Office, 2015), https://www.gao.gov/products/gao-15-188.

87. Despite difficulty in consistent comparisons between SOF and service acquisition actions, one measure of effectiveness is Defense Acquisition Workforce Awards. SOF AT&L-K personnel consistently win these awards at higher rates, a reflection of the culture and empowerment of personnel. USSOCOM won 3 of 23 categories in 2019, including service acquisition, small business, and small organization

categories. See "2019 Defense Acquisition Workforce Award Winners," *Office of the Under Secretary of Defense for Acquisition and Sustainment*, accessed 30 November 2022, https://www.hci.mil/what-we-do/awards/Awards-2019.html.

88. USSOCOM has undergone significant restructuring since the Global War on Terrorism era, including in the area of acquisition activities. These changes were part of the DOD response to the National Defense Authorization Act for Fiscal Year 2014, which addresses congressional concerns for operational funding disagreements between USSOCOM and the Services. The GAO notes the DOD is convinced the reorganization addresses the funding issue, though there is insufficient detail for the GAO to make an assessment. See *Special Operations Forces: DOD's Report to Congress Generally Addresses the Statutory Requirements but Lacks Detail*, GAO-14-820R (Washington, D.C.: Government Accountability Office, 2014), https://www.gao.gov/products/gao-14-820r. See also Elvira N. Loredo et al., *Authorities and Options for Funding USSOCOM Operations* (Santa Monica: RAND Corporation, 2014).
89. The five tenets of the USSOCOM acquisition model are speed, risk tolerance, scale, inclusivity, and relationships. See Capobianco and Phillips, "Strengths and Myths."
90. Richard H. Shultz and Richard D. Clarke, "Big Data at War: Special Operations Forces, Project Maven, and Twenty-First Century Warfare," *Modern War Institute*, 25 August 2020, https://mwi.usma.edu/big-data-at-war-special-operations-forces-project-maven-and-twenty-first-century-warfare/.
91. Christian G. Elebaum, "Organizational Design for USSOCOM Rapid Acquisition" (master's thesis, National Defense University Joint Forces Staff College, Joint Advanced Warfighting School, 2017), https://apps.dtic.mil/dtic/tr/fulltext/u2/1032272.pdf.
92. The insight is taken from Luke Ellery, research director at Gartner, who stated that "Technology procurement is no longer a tactical function. It now plays a strategic role and has the ability to differentiate the organization from the competition." See Christy Pettey, "Top Trends in the Future of IT Procurement," *Gartner*, 16 July 2018, https://www.gartner.com/smarterwithgartner/top-trends-for-the-future-of-it-procurement/.
93. The DOD's failure to establish a consistent technology reduces institutional buy-in necessary to sustain disruptive innovation development. Paul Scharre and Ainikki Riikonen, "The Defense Department Needs a Real Technology Strategy," *Defense One*, 21 April 2020, https://www.defenseone.com/ideas/2020/04/pentagon-needs-technology-strategy/164764/. The fiscal year 2021 budget perpetuated the trend that "clear and sustained commitment to key technologies" is still lacking. See Seamus P. Daniels et al., "What to Look for in the FY 2021 Defense Budget Report," *Defense One*, February 2020, http://defense360.csis.org/wp-content/uploads/2020/02/FY-2021-Preview-Brief_FINAL.pdf. Inconsistent national technology priorities and USSOCOM's reliance on other actors to fund R&D activity is a potential vulnerability for the command. Identification of key SOF-peculiar disruptive innovations should coincide with lobbying efforts in

the Services, Congress, and the private sector if top technology priorities are identified.

94. Forecasts of U.S. military decline have been common in the media, service journals, and think-tank reviews since the end of the Cold War. Recent calls, particularly in the great power rivalry dynamics, may be more accurate due to inconsistent U.S. national technology planning. The Third Offset framework may not survive multiple presidential administrations, let alone developing the actual capabilities. While the Third Offset framework was too ambiguous for national technology planning, it did, at a minimum, identify priority research areas. For a cautionary review of the strategy, see M.L. Cavanaugh, "False Faith: The Third Offset Isn't a Strategy and Won't Win Our Next War," *Modern War Institute*, 10 February 2017, https://mwi.usma.edu/false-faith-third-offset-isnt-strategy-wont-win-next-war/. For a discussion of the negative effects generated by the lack of national technology strategy, see "Absent a New National Strategy, the U.S. Risks Losing Its Edge to China in Technology and Innovation, Warns Task Force," *Council of Foreign Relations*, 18 September 2019, https://www.cfr.org/news-releases/absent-new-national-strategy-us-risks-losing-its-edge-china-technology-and-innovation.

95. Several methods exist to evaluate procurement performance in the private sector. At the core of each model is the identification of limitations and pairing of capabilities within a distinct framework. Application of Ishikawa analysis, or fuzzy data analysis, requires access to extensive information from across SOF AT&L to conduct the analysis. For information on the analysis types, see R. Rajesh, V. Ravi, and R. Venkata Rao, "Selection of Risk Mitigation Strategy in Electronic Supply Chains Using Grey Theory and Digraph-Matrix Approaches," *International Journal of Production Research* 53, no. 1 (2015): 238–257; Mario Coccia, "The Fishbone Diagram to Identify, Systemize and Analyze the Sources of General-Purpose Technologies," *Journal of Social and Administrative Sciences* 4, no. 4 (2019): 291–303.

96. Interviews completed in June 2019, MacDill AFB.

97. Failure avoidance means that manageable risks are avoided but also means loss of potential high-level success. In this context, failure aversion culture is the unwillingness to accept that perfection in delivery of capabilities does not occur rather than failure as a zero or one proposition. Willingness to recognize existing limitations and adapt cultural, personnel, and policy shifts will enable organizational change to ensure continued excellence. Early failures and the opportunity to learn and improve are necessary if SOF AT&L will truly push capabilities through disruptive innovations. The entrepreneurial spirit of risk acceptance will be necessary for revolutionary acquisition. For a review of failing early, see Major Timothy Trimailo, "Epic Fail: Why Leaders Must Fail to Ultimately Succeed," *Military Review*, November-December 2017, https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/November-December-2017/Epic-Fail-Why-Leaders-Must-Fail-to-Ultimately-Succeed/. For an analysis of leadership development in military context and

the importance of risk tolerance, see Tim Kane, *Bleeding Talent: How the U.S. Military Mismanages Great Leaders and Why It's Time for a Revolution* (New York: Palgrave Macmillan, 2012). In addition to hardware and software, cultural improvements are necessary for the U.S. military to successfully retain its global edge. For a review of Army culture, see David Barno and Nora Benshahel, "Six Ways to Fix the Army's Culture," *War on the Rocks*, 6 September 2016, https://warontherocks.com/2016/09/six-ways-to-fix-the-armys-culture/.

98. In follow-up discussion with procurement personnel, AE involvement was thoroughly debated. The director of procurement maintains that AE involvement in procurement is infrequent, consistent with other organizations in the DOD, and largely related to unique instances where timing is most critical. Existing policies are sufficient for the mission. I have opted to leave this point in after reviewing the interviews as multiple participants independently identified AE involvement as a symptom of organizational strain.

99. Following several high-profile misconduct incidences, the USSOCOM commander directed a comprehensive review of the Force. The review found that "USSOCOM has a systemic ethics problem. The Review Team did assess that in some instances USSOCOM's cultural focus on SOF employment and mission accomplishment is to the detriment of leadership, discipline and accountability." See *United States Special Operations Command Comprehensive Review* (MacDill Air Force Base: United States Special Operations Command, 2020), http://www.sof.news/pubs/USSOCOM-Comprehensive-Ethics-Review-Report-January-2020.pdf. Some of the report's findings are in contrast with the final finding that systematic failure is not an issue. See Matthew Cox, "Decades of Combat Led to SEAL Team Discipline Issues, Acting Navy Secretary Says," *Military.com*, 6 December 2019, https://www.military.com/daily-news/2019/12/06/decades-combat-led-seal-team-discipline-issues-acting-navy-secretary-says.html; Meghann Myers, "Spec Ops in Trouble: Mired in Scandal and Under Pentagon Review, What Will It Take to Clean House?" *Military Times*, 13 March 2019, https://www.militarytimes.com/news/your-army/2019/03/13/spec-ops-in-trouble-mired-in-scandal-and-under-pentagon-review-what-will-it-take-to-clean-house/. Continuous warfare over two decades may generate systematic problems that lead to discipline breakdowns. USSOCOM-conducted reviews, moreover, may miss fundamental limitations affecting the Force. See David Barno and Nora Bensahel, *Adaptation Under Fire: How Militaries Change in Wartime: Bridging the Gap* (New York: Oxford University Press, 2020). Additional civilian oversight through strengthening the assistant secretary of defense for special operations and low intensity violence is likely insufficient to ensure Force changes. Additional civilian oversight will likely be required. See Mitchell, Griffiths, and Livieratos, *Adrift*.

100. Interviews conducted with SOF AT&L personnel in February 2015 and June 2019 at MacDill, AFB.

101. There are no studies specific to SOF and a millennial workforce. An analysis of millennials in the U.S. tailored to the intelligence community found that millennials generally lack trust in the federal government yet believe the government

has extensive responsibilities to establish security and provide national defense. For an extensive discussion, see Cortney Weinbaum, Richard Girven, and Jenny Oberholtzer, *The Millennial Generation: Implications for the Intelligence and Policy Communities* (Santa Monica: The RAND Corporation, 2016).

102. The federal workforce is top heavy with individuals at or near retirement age according to the U.S. Bureau of Labor Statistics. See Mike Ramsey, "The Evolving Federal Workforce: President Joe Biden Wants to Revitalize the Federal Workforce. But That Could Prove Challenging," *Society for Human Resource Management*, 27 March 2021, https://www.shrm.org/hr-today/news/all-things-work/pages/building-a-better-federal-workforce.aspx. The post-millennial generation, NetGen, is defined as those born after 1997. Some analysts ascribe NetGen with digital native characteristics since they have always had instant connectivity. Some analysts identify key strengths of NetGen as more intellectually prepared, confident, and financially astute than the millennial generation. These factors will shift how communication, training, and leadership operate. For an analysis of NetGen effects on the military, see K.C. Reid, "How the Network Generation Is Changing the Millennial Military," *War on the Rocks*, 20 March 2018, https://warontherocks.com/2018/03/how-the-network-generation-is-changing-the-millennial-military/.

103. Maximization of the Department of Defense Acquisition Workforce Development Account's opportunities to repay student loans is one potential retention tool. See *Department of Defense Acquisition Workforce Development Account*, 10 U.S.C. 1705 (2008), https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title10-section1705&num=0&edition=prelim#sourcecredit.

104. Tkach, *Contracting*, 2017.

105. Short military duration was identified during several interviews. The short military rotations impact acquisition personnel because credentials may not transfer (extending spin-up time) and current contracts may lack sufficient notation to enable smooth transitions. Interviews conducted June 2019 at MacDill, AFB.

106. In interviews, the perception that SOF AT&L-K is special is conditioned by an individuals' experience outside the organization. One such comment, that a new employee thought "SOF was special, after a year, it doesn't feel that special" is also reflected in business surveys that found SOF AT&L-K rated higher than other DOD agencies but not significantly higher.

107. Telework is not new to the federal government or the DOD. The Telework Enhancement Act of 2010 establishes policies for departments to establish telework. DOD adoption of telework accelerated even before the SARS-CoV-2 pandemic. The pandemic obviously accelerated trends to the point that telework expansion and the network required to sustain it will be permanent. Todd Lopez, "Growth in DOD Telework Capability May Outlive Coronavirus Pandemic," *U.S. Defense Department*, 13 April 2020, https://www.defense.gov/Explore/News/Article/Article/2147123/growth-in-DOD-telework-capability-may-outlive-coronavirus-pandemic/. Federal policies on telework are found at telework.gov. Classified telework also occurs, and the Navy is pioneering the use of specialized software and commercial laptops to satisfy telework requirements. See Theresa

Hitchens, "New Air Force deviceONE to Allow Remote Top-Secret Access for Services, IC," *BreakingDefense*, 7 May 2020, https://breakingdefense.com/2020/05/new-air-force-deviceone-to-allow-remote-top-secret-access-for-services-ic/.

108. When asked follow-up questions about the lack of telework, several KOs simply stated it was a command decision. Interviews conducted with procurement personnel in June 2019, MacDill AFB.

109. Follow-up conversation with Colonel Obergfell, director of procurement, identified the extensive tracking system used to monitor KO productivity. Telework has improved efficiency in terms of actions and dollar amounts.

110. SOF AT&L-K excels in one critical area of millennial retention: belief in the mission of the organization. According to GAO analysis, employee engagement is most conditioned by the behavior of the employer, not necessarily the age. Nearly every interviewee of SOF AT&L-K personnel in 2016 and 2019 stated an affinity for the mission as a top employment draw. However, the GAO also identifies five additional characteristics for millennial retention with two characteristics, career development and training and employee involvement, identified by personnel as limitations in the command. See *Federal Workforce: Lessons Learned for Engaging Millennials and Other Age Groups*, GAO-16-880T (Washington, D.C.: Government Accountability Office, 2016).

111. Organizational loyalty is just one of many features of millennial employees from previous generations. Pertinent for military organizations is the transition from authority to relational models of authority. Because millennials are sufficiently different, scholars developed new models of workplace interaction to study behaviors. For a history of the evolution of the workforce, see Robert G. DelCampo, Lauren A. Haggerty, Meredith Jane Haney, and Lauren Ashley Knippel, *Managing the Multi-Generational Workplace: The GI Generation to the Millennials* (Burlington: Gower Publishing Company, 2010). See also Janis Bragan Balda and Fernando Mora, "Adopting Leadership Theory and Practice for the Networked, Millennial Generation" *Journal of Leadership Studies* 5, no. 3 (2012): 13–24. For a review of millennial implications for the DOD, see Darlene E. Stafford and Henry S. Griffs, *A Review of Millennial Generation Characteristics and Military Workplace Readiness* (Alexandria: The CAN Corporation, 2008).

112. Tkach, *Special Operations Command Contracting.*

113. As a percentage, interviewees in the procurement directorate estimated time spent on emails from 30 to 95 percent of their time. The email burden is clearly substantial even without precise measurements. Interviews conducted with procurement personnel in June 2019, MacDill AFB.

114. Another example is LinkedIn. LinkedIn upended its customer retention practices after identifying that the best predictor of business retention was whether the company used the platform in the first months of the contract. LinkedIn changed its engagement practices to utilize engagement specialists at the beginning of contracts instead of the end, which improved overall retention. Both examples

are from Dan Heath, *Upstream: The Quest to Solve Problems before They Happen* (New York: Simon and Schuster, 2020).

115. Colonel Joe Capobianco and David Phillips, "Aggressive. Innovative. Fast." *Army Rapid Capabilities and Critical Technologies Office*, 3 July 2018, https://rapidcapabilitiesoffice.army.mil/news/Aggressive-Innovative-Fast/.

116. Data provided by Colonel Obergfell includes 146 filled positions and 24 vacancies, representing approximately a 14 percent decline from full strength. In a survey of over 770 DOD contracting officials, the top category for successful procurement was adequate workforce (38 percent) followed by relationships (17 percent) and processes (16 percent). See R. Rendon, "Defense Procurement: An Empirical Analysis of Critical Success Factors," in G. L. Albano, K. F. Snider, and K. V. Thai, eds., *Charting a Course in Public Procurement Innovation and Knowledge Sharing* (Boca Raton: PrAcademics Press, 2012): 174–208.

117. Over 40 percent of interviews identified legal bottlenecks. Interviews with KOs were completed in June 2019 at MacDill, AFB.

118. Additional areas where AI is applied are legal research/due diligence, documentation review, and prediction of legal outcomes. "Three Ways Law Firms Can Use Artificial Intelligence," *Law Technology Today*, 19 February 2019, https://www.lawtechnologytoday.org/2019/02/three-ways-law-firms-can-use-artificial-intelligence/.

119. Nicole Black, "Here's the Lowdown on Contract Analysis Software," *ABA Journal*, 23 March 2018, http://www.abajournal.com/news/article/heres_the_lowdown_on_contract_analytics_software.

120. The contract review software, LawGeex, achieved a 94 percent accuracy rating at identifying risks in nondisclosure agreements. Only 1 of the 132 human lawyers achieved that high accuracy rate with the lowest achieving only 68 percent accuracy. Substantial time differences are significant: LawGeex took 26 seconds to complete the task while humans averaged 92 minutes. Obviously, NDAs have limited applicability to SOF AT&L-L contracting processes (outside of existing NDAs). The AI example with NDAs is to demonstrate the potential of AI to revolutionize law. NDAs were selected because human coders can differentiate between complete and incomplete NDAs to assist in ML. SOF acquisition processes are unique but not so unique that AI would not apply if investments are made. For a review of the study comparing coders, see Audrey Herrington, "How AI Can Make Legal Services More Affordable," *SmartLawyer*, 23 July 2019, http://www.nationaljurist.com/smartlawyer/how-ai-can-make-legal-services-more-affordable.

121. Additional areas of AI-assisted legal services include review of RFI and RFPs to predictively identify potential downstream problems.

122. David Roe, "11 Industries Being Disrupted by AI," *CMSWire*, 17 April 2018, https://www.cmswire.com/information-management/11-industries-being-disrupted-by-ai/.

123. PPP and private sector collaboration are distinct. Collaborations are very common in the U.S. as numerous fields from aviation to communication were initially collaborations between the private and public sectors. The development and

application of disruptive innovations will require extensive collaboration. Unlike other technologies such as satellite, where military applications dominated early development before transitioning to commercial applications, disruptive innovations such as the internet became hybrids with public and private applications.

124. D. Grimsey and M.K. Lewis, *Public Private Partnership* (Cheltenham: Edward Elgar, 2004).

125. Eva I. Hoppe, David J. Kuster, and Patrick W. Schmitz, "Public-Private Partnerships versus Traditional Procurement: An Experimental Investigation," *Journal of Economic Behavior and Organization* 89 (2013): 145–166. A government's goal influences the effectiveness of PPP. PPPs are most advantageous when a government balances maximizing consumer surplus and public revenue and is least effective when only focusing on consumer surplus. The implication for SOF is that PPP service contracts that are too niche (e.g., too few operational environments, users, or Service applications) may not be appropriate. However, if a service is scalable to a sizable portion of SOF or the Services, PPP offers an opportunity to pursue disruptive innovation while controlling development and costs. See Shiliang Cui, Zhou Fend, and Yiwen Zhang. "Is Public-Private Partnership Better than Traditional Procurement: An Analysis Under Nash Bargaining," *SSRN*, 1December 2019, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3502954.

126. Arman Avadikyan and Patrick Cohendet, "Between Market Forces and Knowledge Based Motives: The Governance of Defense Innovation in the UK," *The Journal of Technology Transfer* 34 (2009): 490–504.

127. Interviews with KOs were completed in June 2019 at MacDill, AFB.

128. Christian Lohmann and Peter G. Rotzel, "Opportunistic Behavior in Renegotiations between Public-Private Partnerships and Government Institutions: Data on Public-Private Partnerships in the German Armed Forces," *International Public Management Journal* 17, no. 3 (2014): 387–410.

129. Rick E. Yannuzzi, "In-Q-Tel: A New Partnership between the CIA and the Private Sector," *Defense Intelligence Journal* 9, no. 1 (2000).

130. Amy Zegart and Michael Morrell, "Spies, Lies, and Algorithms: Why U.S. Intelligence Agencies Must Adapt or Fail," *Foreign Affairs* (May/June 2019): 85–96; Tarah Wheeler, "In Cyberwar, There Are No Rules," Foreign Policy, 12 September 2018, https://foreignpolicy.com/2018/09/12/in-cyberwar-there-are-no-rules-cybersecurity-war-defense/.

131. Innovation generated by defense spending is conditioned by the diffusion of the knowledge and technology. Schmid found that patent protection, more than other features, affects the diffusion of military-developed technology. Jon Schmid, "The Diffusion of Military Technology," *Defense and Peace Economics* 29, no. 6 (2017): 595–613. See Michael Horowitz, *The Diffusion of Military Power.*

132. "About SOFWERX," *SOFWERX*, accessed 30 November 2022, https://www.sofwerx.org/about/.

133. The initial program established by USSOCOM Commander McRaven set a 2019 deadline for a working prototype, which is considered the success benchmark.

Later revisions highlighted the importance of spin-off technology and business operation innovation. See Vivienne Machi, "'Iron Man Suit' Prototype Delivered by 2019, SOCOM Officials Vow," *National Defense*, 24 May 2018, https://www.nationaldefensemagazine.org/articles/2018/5/24/socom-leadership-confident-of-delivering-talos-prototype-by-2019; Sydney J. Freedbreg, Jr., "SOCOM Builds Iron Man, Piece by Piece," *Breakingdefense.com*, 29 January 2015, https://breakingdefense.com/2015/01/socom-builds-iron-man-piece-by-piece/.

134. The most substantial difficulty for the government as lead integrator model is the lack of government expertise. See William E. Novak and James D. Smith II, "Government as the Integrator: Why, Why Not and How?" (presentation, Software Solutions Conference, Pittsburgh, Carnegie Mellon University, 16 November 2015): 9.

135. *Business Systems Modernization: DOD Has Made Progress in Addressing Recommendations to Improve IT Management, But More Action Is Needed*, GAO-20-253 (Washington, D.C.: Government Accountability Office, 2020). The DOD has implemented changes to address establish business system investment and management guidance and ensure business system investment review and certification.

136. *DOD Business Systems Modernization: Further Actions Needed to Address Challenges and Improve Accountability*, GAO-13-557 (Washington, D.C.: Government Accountability Office, 2013); *Defense Business Systems: DOD Needs to Continue Improving Guidance and Plans for Effectively Managing Investments*, GAO-18-130 (Washington, D.C.: Government Accountability Office, 2018).

137. Extensive use of OTAs is affecting overall federal contracting totals. For an examination of OTAs in general, see "A Reminder of the Key Provisions of the FY21 National Defense Authorization Act," *Georgia Tech Contracting Education Academy*, 11 February 2021, https://contractingacademy.gatech.edu/tag/other-transaction-agreements/. The DOD has enthusiastically embraced OTAs since the 2016 change, using the authority in 618 new prototype orders or modifications, up from 248 in 2016. See *DOD's Use of Other Transaction for Prototype Projects Has Increased*, GAO-20-84 (Washington, D.C.: Government Accountability Office, 2019). The increased use of OTA increased the likelihood of prototyping or transitioning capability simply because of their increased use. The Army's squad multipurpose equipment transport (SMET) contract was cancelled following a protest but before GAO review. The highly unusual process resulted from allegations that the Army improperly conducted the OTA during the transition from prototype to production contract. See Stew Magnuson, "A High-Profile OTA Program Goes Off the Rails," *National Defense*, 4 May 2020, https://www.nationaldefensemagazine.org/articles/2020/2/4/a-high-profile-ota-program-goes-off-the-rails.

138. During multiple interviews, SPS/P2D software was both praised and admonished. One potentially innovative approach is to have industry write contracts for the government. In this flipped environment, contractors supply everything from SOW to procurement, potentially producing time and cost savings by shifting the burden for contracting process to competitors. This hypothetical

is not possible under the FAR. Instead, conducting simulations of flipped contracting processes may identify limitations in existing processes or initial solicitations. See Stephen C. Hail, "A Better Way to Write a Contract," *Defense Acquisition University*, 1 March 2017, https://www.dau.edu/library/defense-atl/blog/A-Better-Way-to--Write-Contracts.

139. Contract closeouts were frequently mentioned as duties required but delayed because of time pressures. Interviews conducted June 2019 at MacDill, AFB.

140. Neha Desai Shah, The Future of Procurement Technology: Portable, Powerful, Pivotal (Clark: GEP, 2020), https://www.gep.com/white-papers/future-procurement-technology.

141. C. Todd Lopez, "COVID-19 Pandemic Reveals Supply Chain Vulnerability," *U.S. Department of Defense*, 16 July 2020, https://www.defense.gov/Explore/News/Article/Article/2276540/covid-19-pandemic-reveals-supply-chain-vulnerability/; David Vergunn, "Pandemic Revealed Supply Chain Vulnerability, Pentagon Official Says," U.S. Department of Defense, 8 July 2020, https://www.defense.gov/News/News-Stories/Article/Article/2267558/pandemic-revealed-supply-chain-vulnerability-pentagon-official-says/.

142. Current generation efforts at social media intelligence focus on messaging: misinformation, disinformation, and mal-information. Existing prototyping efforts to adapt a COTS product are designed to understand the information environment and detect, contextualize, and present tactically useful, whole-of-network insights. Yet, identification and analysis of social media in real time is an incremental improvement over existing capability. https://beta.sam.gov/opp/8c7d1d33507c45e398f2ba3fe5fae7ad/view. Machi, "Special Operations Command Needs New Tech."

143. Shultz and Clarke, "Big Data."

144. See Lyle J. Morris et al., "Gaining Competitive Advantage in the Gray Zone: Response Options for Coercive Aggression below the Threshold of Major War" (Santa Monica: RAND Corporation, 2019) and Elizabeth Bodine-Baron et al., *Countering Russian Social Media Influence* (Santa Monica: RAND Corporation, 2018).

145. Isabella Hansen and Darren J. Lim, "Doxing Democracy: Influencing Elections via Cyber Voter Interference," *Contemporary Politics* 25, no. 2 (2019): 150 –171; Travis Sharp, "Hiding in Plain Sight: Political Effects of Cyber Operations," *Survival* 60, no. 6 (2018): 45–53; Daniel Coats, "Worldwide Threat Assessment of the U.S. Intelligence Community" (2018), https://www.dni.gov/files/documents/Newsroom/Testimonies/2018-ATA---Unclassified-SSCI.pdf. Social mobilization occurs outside advanced industrial democracies. For example, see Amanda Taub and Max Fisher, "Where Countries Are Tinderboxes and Facebook Is a Match: False Rumors Set Buddhist against Muslim in Sri Lanka, the Most Recent in a Global Spate of Violence Fanned by Social Media," *The Interpreter*, 21 April 2018, https://www.nytimes.com/2018/04/21/world/asia/facebook-sri-lanka-riots.html.

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147. Stephanie Edgerly et al., "When Do Audiences Verify? How Perceptions about Messages and Source Influence Audience Verification of News Headlines," *Journalism & Mass Communication Quarterly* 97, no. 1 (2020): 52–71.
148. Thoroughgood et al., "The Susceptible Circle."
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152. Shultz and Clarke, *Big Data*.
153. Shultz and Clarke, *Big Data*.
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