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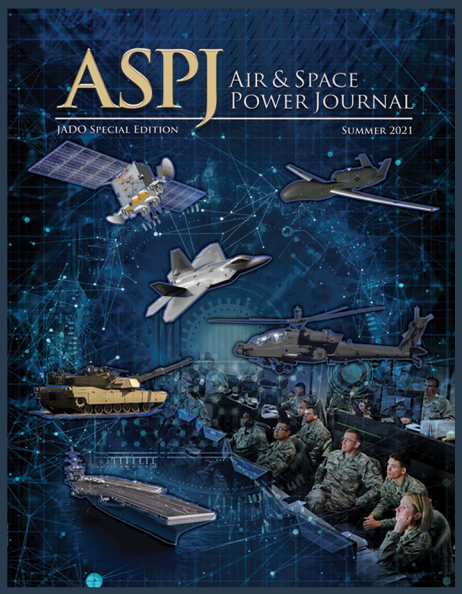

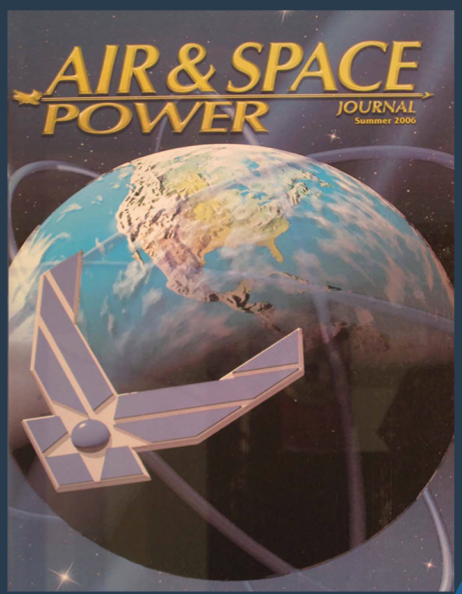

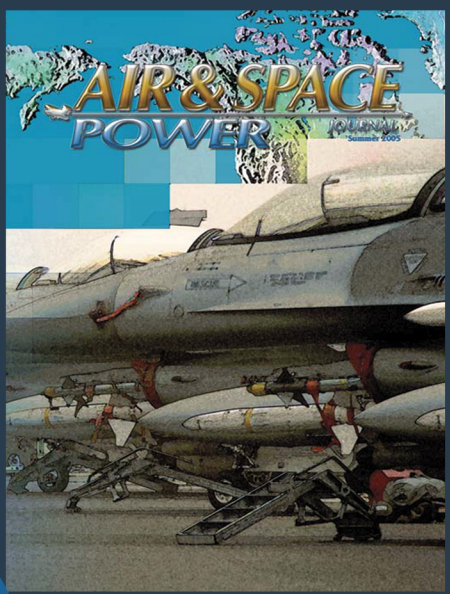

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FROM THE EDITOR

Dear Reader,

Thank you for your interest in this issue of *Air & Space Power Journal* (*ASPJ*). Our Winter edition features articles on airpower theory, organizational culture, improved resource management, and a forum entitled *Looking Back*. In our lead article, "The Underdog's Model: A Theory of Asymmetric Airpower," Arash Heydarian Pashakhanlou presents an airpower theory model that explains six factors necessary for a smaller air force to prevail against a larger adversary.

In "Department of Defense Laboratories: Recalibrating the Culture," Edie Williams carries forward a theme from our Fall 2021 issue, that of a needed reexamination of the current roles and responsibilities of Department of Defense scientists and engineers. She engages the three levels of organizational culture conceptualized by Edgar Schein to argue the DOD Labs need to embrace high-risk, high-reward innovation, moving away from the more structurally measured approaches to innovation adopted over the past two decades.

Our forum on resource management features two articles. Joshua Reese, Jonathan Ritschel, Brent Langhals, and Ryan Engle discuss a novel approach to leveraging military costs in the wargame component of the Joint planning process in "Integrating Cost as a Decision Variable in Wargames." In "Cost-of-Delay: A Framework for Air Force Software Factories," James Goljan, Jonathan Ritschel, Scott Drylie, and Edward White present findings from research applying a modified cost-of-delay process to a public sector Air Force entity.

The reviews in the second section of our Winter issue were solicited from faculty across Air University with the express purpose of looking back at the last two decades of the journal. *Looking Back* analyzes three particularly worthwhile articles for their relevance today.

The issue returns to airpower theory as Daniel Connelly and Tony Hughes review Michael Pixley's 2005 article "False Gospel for Airpower Strategy? A Fresh Look at Giulio Douhet's *Command of the Air*." They find Pixley's call to reexamine Douhet not only relevant but critical. As we approach the second birthday of the US Space Force, Galen Ojala details the prescient insights of Mark Harter's 2006 article, "Ten Propositions Regarding Space Power: The Dawn of a Space Force." Jonathan Mahan highlights a theme raised by Pashakhanlou and by Connelly and Hughes and determines Raymond Hain's 1999 *ASPJ Chronicles* article, "The Use and Abuse of Technology: In Insurgent Warfare" speaks truth to today's predilection for technological innovation at the expense of the human, social, and cognitive domains.

This commemoration of *ASPJ* helps honor the intellectual rigor the journal and its authors have upheld over the past two decades and serves to announce some exciting changes ahead. In the spring, *ASPJ* will move to a digital-only PDF format and will adopt a slightly different name, explicitly reflecting the journal's traditional focus on operations: *Air & Space Operations Review*.

Tighter budgets and changing media preferences among our readership loom large. The Air Force, like the rest of the US military, must reallocate perpetually limited resources to where they are best utilized. Air University Press, facing an almost 50 percent budget cut and in recognition of the media preferences of the Airman, Guardian, and friends readership of today, determined moving *ASPJ* to a digital-only publication was the best way to address both challenges.

Name changes for the journal have precedence: *ASPJ* is the fifth name of what began as the "professional journal of the Air Force" in 1947, *Air University Quarterly Review*. In 1963, the journal moved to a bimonthly publication schedule and "Quarterly" was dropped from the name. In 1987, facing what the editor at the time described as "a devastating budget cut," the journal was moved to the Center for Aerospace Doctrine, Research, and Education (CADRE), now the LeMay Center. Under CADRE, *Air University Review* was renamed a third time to *Airpower Journal*.

Twelve years later in 1999, General Mike Ryan, in introducing the renamed *Aerospace Power Journal*, noted the new moniker represented "our vertical vector into the wild blue and our thrust for cutting-edge technologies and robust systems." He declared the journal would "advance important discussions about strategy, operational art, national defense, and how the Air Force can continue the outstanding team effort that makes [it] the world's finest aerospace force." Then, just over two years after Ryan heralded in his letter that it was "here to stay!" General John Jumper announced the newly renamed *Air & Space Power Journal* in mid-2002. "Aerospace" wrote Jumper, "fails to give the proper respect to the culture and to the physical differences that abide between the environment of air and the environment of space."

These changes come as part of a broader transformation that includes *Strategic Studies Quarterly* (*SSQ*). In early spring 2022, the journals currently named *ASPJ* and *SSQ* will be housed under a single digital platform called *Æther*, and *SSQ* will take the platform name as its own. *Æther: A Journal of Strategy and Airpower* will continue its print distribution for the foreseeable future, and current subscribers to *ASPJ*'s print journal may request to be added to the *Æther* distribution list. The journals will continue to complement each other—one operational, one strategic—and both will move forward in the tradition of the Air Force flagship journal effort.

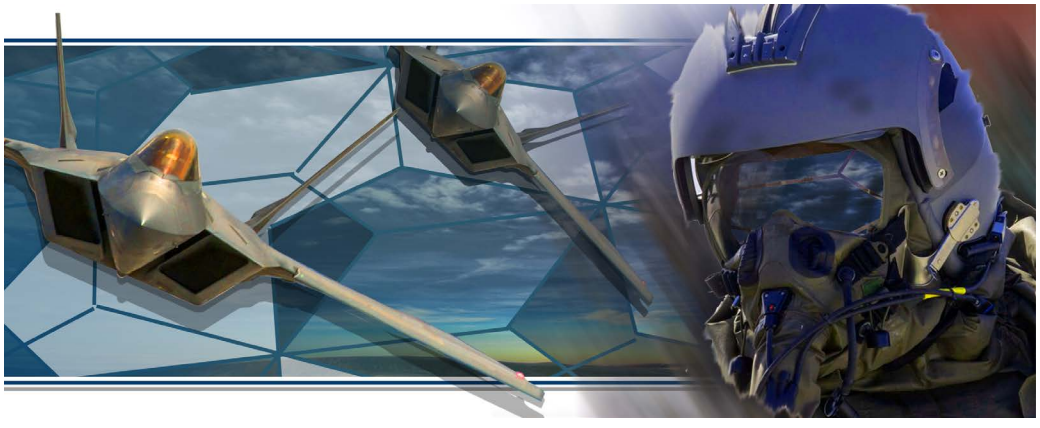
Change is, at times, uncomfortable, but it is a part of daily life. We take the directive of General Charles Q. Brown Jr. very seriously—"accelerate change or lose!" As we implement the new platform, we want to express our deep appreciation for you, our reader. The editor at the time of the most significant change in the history of this journal, when *Air University Review* was formally dissolved in 1987, lamented that "perhaps tragically, far too many officers never bothered to read their professional journal." The journal staff is highly cognizant of the fact that today's Airmen, Guardians, and other readers have myriad options when it comes to professional reading. We are grateful for you and others who find value in the family of professional journals of the Air Force published by Air University Press—*ASPJ*, *SSQ*, the *Journal of the Americas*, and the *Journal of Indo-Pacific Affairs*—as well as the books and papers series published by the Press. We will continue to provide readers with scholarly, insightful work, and we will continue to provide authors with opportunities to be published in rigorous, scholarly publications that have the academic freedom to critically engage Air Force, US military, and national security strategy, policies, plans, and operations.

~The Editor

The Underdog's Model

A Theory of Asymmetric Airpower

Arash Heydarian Pashakhanlou



The airpower assets of nations vary greatly.* The United States operates the world's largest active military aircraft fleet—13,232—followed by Russia with 4,143, whereas the Ivory Coast Air Force only has 5 military aircraft.[1] Despite these vast discrepancies, the influential airpower theories of Giulio Douhet, John Boyd, John Warden, and Robert Pape do not focus on the crucial issue of asymmetry. This gap in the literature is problematic in light of existing realities.

This article proposes a smaller-party-focused asymmetric airpower theory entitled the Underdog's Model (UM). This model aims to explain situations where the abilities of warring parties to project military force applied within or from the air environment differ significantly. The theory is formulated based on empirical data from the air forces of Sweden, Finland, and Israel, and on specific asymmetric wars including the Russo-Finnish War, also known as the Winter War (1939–40), the US intervention in the Vietnam War (1965–73), and the Yom Kippur War (1973).[2]

Some of these cases have been studied extensively.[3] But the literature concerned with asymmetric airpower as such is limited and at times focused on the preponderant power.[4] The body of work predominantly preoccupied with the smaller

* The author would like to thank the participants at the War Studies Seminar at the Swedish National Defence University along with Christina Ahremark, Jacqueline Anwar, Magnus Bengtsson, Anders Brunvall, Tommy Enkvist, Anders Frykholm, Per Hård af Segerstad, Björn Johnson, Tomas Larsson, Nicola Nymalm, Mike Palmer, Peter Thunholm, Emil Walter, Jerker Widén, and the anonymous reviewers. This research was supported by the Swedish Armed Forces.

party is therefore rare but does exist. For instance, Bernard Cai Hanjie argues airpower is strategically beneficial for small states in war and peace due to its speed, reach, flexibility, and elevation—imperative to ensure the continued existence of his native Singapore as it lacks natural strategic depth.[5]

Likewise, Philip Sabin considers the various measures underdogs have taken from the 1940s to the 1990s to counter the airpower of superior foes and concludes they rarely win. They may nevertheless cause serious problems, and Sabin advises Western powers to gain an understanding of the political and cultural nature of their adversaries to avoid such outcomes.[6]

To date, the former wing commander of the Royal New Zealand Air Force, Shaun Clarke, has engaged most extensively with the issue of asymmetric airpower. His strategic persuasion-oriented targeting (SPOT) paradigm suggests small powers should launch high-impact operations aimed at changing the political calculations of their opponent through operational and strategic surprise. These operations should be conducted through military and civilian efforts and take the international law of armed conflict into consideration.

Specifically, Clarke contends small nations should not seek to annihilate the enemy as it is beyond their means. They should rather persuade its leadership to make concessions by launching strategic air strikes against them. These operations should be conducted jointly and in combination with diplomatic measures to pressure the supreme decision-making body of the adversary to alter its policies. The success of these efforts depends on adequate capability, intelligence, and strategic acumen.[7]

Although overlaps with the writings of Clarke exist in terms of the factors considered, this article is not restricted to the issue of strategic bombing that preoccupies Clarke's publications. Instead, it considers the principles the underdog should adhere to in order to maximize the likelihood of victory against an overwhelming adversary. Moreover, in contrast to Clarke's investigation, these findings are not restricted to small states but apply to relatively disadvantaged states of all types, including middle and great powers. It is these existing gaps in the literature that this inquiry seeks to address.

The specific research question this article considers is: how can states enhance their odds of succeeding against an opponent with quantitatively and occasionally also qualitatively superior airpower assets? The theory devised to answer this question, the "Underdog's Model," posits six factors are essential if David is to succeed against Goliath: (1) creativity, (2) self-sufficiency and external support, (3) commitment, (4) intelligence, (5) dispersion and concentration, and (6) the engagement of vulnerable military targets. The likelihood of David prevailing increases the better it performs in these areas compared to Goliath.

The Underdog's Model

In the Underdog's Model (fig. 1), three interrelated issues determine the success of the disadvantaged state: (1) the extent to which it manages to attain its own objectives, (2) the extent to which it manages to prevent the opponent from achieving their objectives, and (3) the costs it pays for accomplishing these two objectives. Simply put, the lower the price the underdog pays for fulfilling its goals and denying those of its adversary, the more successful it is and vice versa. As noted, the UM posits the better an underdog fares in comparison to its more plentifully equipped nemesis across the previously listed six factors, the greater the likelihood of its success in that armed conflict.

In other words, the Underdog's Model is probabilistic rather than deterministic. Due to the inherent limitations of social science, definitive predictions cannot be made. Consequently, the UM is more cautious. It suggests the greater advantage David enjoys against Goliath across the identified factors, the more likely David will succeed. But the theory does not deterministically assure such outcomes. As mentioned, the factors included in the UM were identified and developed by examining the cases of asymmetric airpower referred to above. In the process, factors such as the geography of the country, although important, were discarded in favor of more malleable generic key factors to enhance the applicability of the model across time and space.

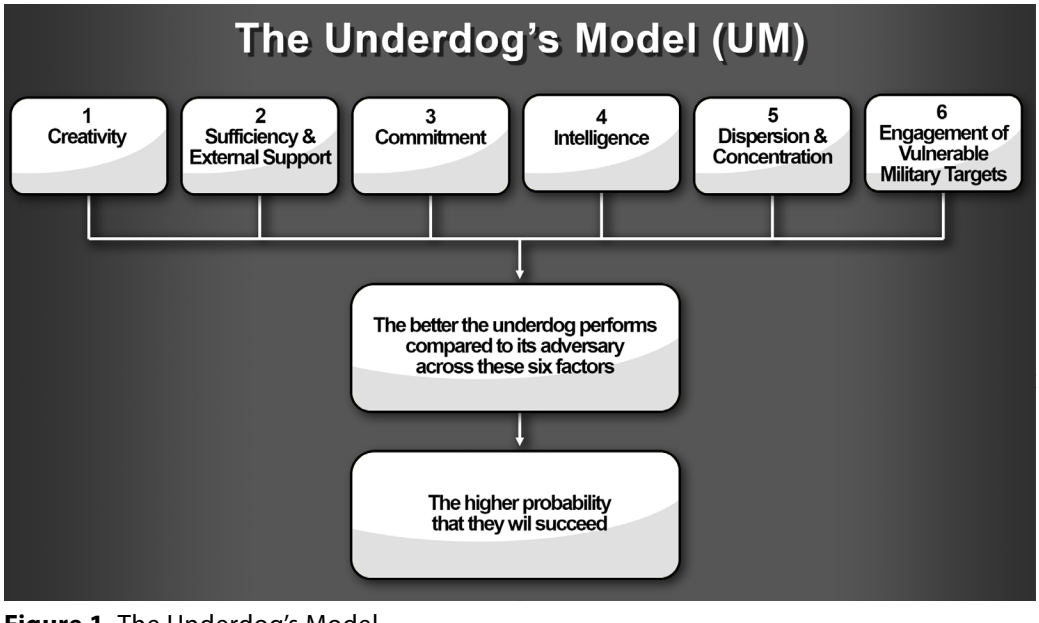


Figure 1. The Underdog's Model

If the underdog outperforms its rival across these six factors and triumphs as a result, the findings are consistent with the model's predictions. Conversely, if the underdog does better than its opponent across the board but still suffers defeat in the air campaign, the case constitutes an anomaly for the UM. Cases where states fail to follow UM prescriptions are not anomalies since it is mainly a prescriptive rather than descriptive theory. It does not seek to explain how states *do* behave in asymmetric settings but rather how they *ought* to act in such situations.

As with all theoretical frameworks, the Underdog's Model will encounter anomalies since it simplifies reality by emphasizing six factors at the cost of others. Yet these simplifications are needed to make sense of a complex reality without getting lost in a myriad of information. In the end, the merits of the UM are determined based on how well and parsimoniously the six factors account for the past, present, and future of asymmetric airpower. The next section examines the first factor it employs for this purpose.

Creativity

Creativity has played a prominent role in Western military thought. Carl von Clausewitz considered the creative genius of a commander essential to manage the frictions of war. That idea has reportedly pervaded Western military organizations ever since.[8] Instead of focusing on the creative genius of a commander, creativity in the Underdog's Model refers to the production of valuable unconventional ideas and/or material assets at the tactical, operational, and/or strategic levels.

In general, the creative process may come about when solutions are sought to problems that arise. As a result, a hypothesis might be formulated and tested that may require further modification and retesting before a viable creative solution is found.[9] In asymmetric airpower, the central conundrum that haunts an underdog is how to make the best use of its relatively limited capabilities. A creative solution to this predicament may considerably improve the prospects of success.

According to existing research, the probability of achieving success is enhanced if intelligent, open-minded, intrinsically motivated, self-confident, hard-working, and impulsive individuals are given this task, since these traits are correlated with creativity. These individuals should be provided with supportive and skilled mentors in their field who can steer their creativity in the right direction. These creative individuals should also be placed in diverse teams where backgrounds and knowledge differ to broaden the information and the number of perspectives available to the group. Respecting and learning from others and building on each other's ideas should be the guiding principles in these forums. Risk taking should be encouraged while hierarchies should be downplayed to foster creativity.[10]

Finland displayed creativity in practice during the 1930s as it sought to remedy its quantitative and qualitative inferiority vis-à-vis the Soviet Union. Specifically, the Finns developed the four-finger formation for this purpose (fig. 2).[11] In this formation, four aircraft make up two pairs, referred to as the "lead element" and the "second element" respectively. The flight leader is up front and has a wingman to his rear left (lead element). The element leader is to the rear right of the flight leader and the element wingman rear right of the element leader (second element). In this formation, the flight leader and element leader have offensive roles and attack enemy aircraft whereas the wingmen are supposed to act defensively and cover their rears.[12]

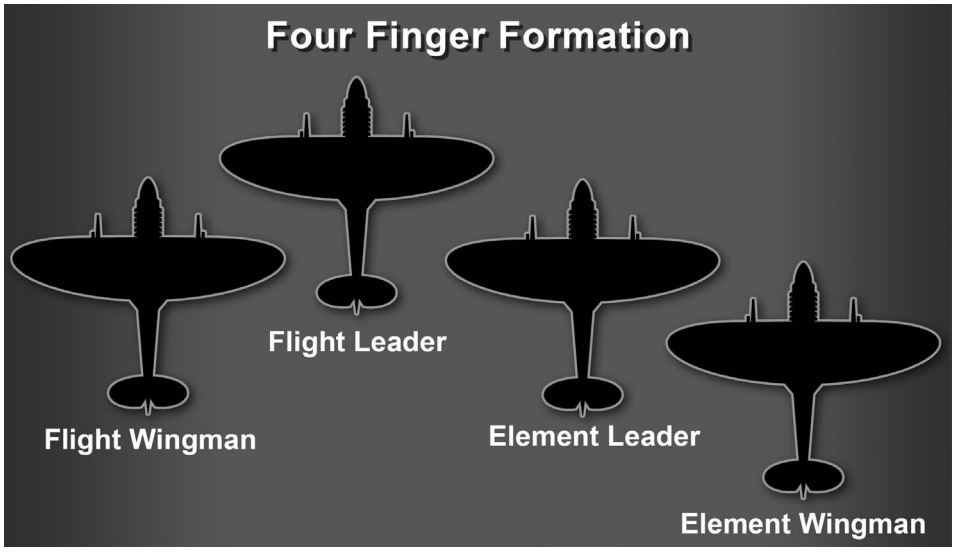


Figure 2. Four-finger formation

The four-finger formation enhanced the vertical and horizontal separation of the Finnish aircraft, improved their situational awareness, and made them more difficult to detect. The flexibility of this formation also enabled their aircraft to split and attack in pairs. In 1939 when the Winter War broke out, the Finnish Air Force tested this creative tactical innovation. They did so against their Soviet opponents that adopted the conventional Vic formation with three aircraft, one up front and the other two in rear right and left positions. Despite the fact the Finns were outnumbered, with inferior aircraft, they reportedly attained a 16:1 kill ratio against the Soviet Air Forces.[13] The literature partly contributes this success to their adoption of the four-finger formation.[14] This demonstrates the importance of creativity in confrontations with a preponderant enemy.

Self-Sufficiency and External Support

The literature on self-sufficiency is far less developed than that on external support. The issue of external support has proven controversial in asymmetric conflict literature. Whereas some scholars regard it largely inconsequential or even counterproductive, others consider external support essential for success.[15] The present investigation concurs with the latter while also emphasizing the significance of self-sufficiency.

Indeed, the Underdog's Model contends the underdog should strive for maximum self-sufficiency and external support in all relevant areas, including politics, logistics, finances, arms, and personnel. The pursuit of self-sufficiency and external support might appear contradictory, but it is not. As will be demonstrated, both elements are imperative for the success of the underdog. Self-sufficiency safeguards against overreliance and dependence on external actors who may decide to withdraw their support at any moment and force the underdog to rely on its capabilities to fend for itself.

As such, the underdog must be able to uphold, sustain, and project airpower on its own to the maximum extent possible. To accomplish these tasks, the air force in question must obtain sufficient military training, experience, and expertise. It must also show commitment to these endeavors and collaborate efficiently with the rest of the armed forces and with the nation as a whole.

Yet it is extremely unlikely the underdog will manage on its own for any length of time, especially in a protracted conflict with a more powerful opponent. Under some conditions, David may not survive very long without a consistent external supply of critical goods. While the underdog should be as self-sufficient as possible, it must also seek maximum external support.

External support refers to assistance derived from outside sources—the aid of foreign actors. Assistance can come in many forms including political, intelligence, training, provision of logistics, arms, money, personnel, and territorial sanctuaries. To be sure, the preponderant power may attempt to stop these efforts by pressuring the external sponsors to terminate their support or physically inhibit their aid through blockades and aerial interdiction. The underdog should use the diplomatic and military instruments at its disposal to prevent the adversary from succeeding in these endeavors.

The importance of self-sufficiency became abundantly clear for Sweden during the World Wars. When World War I broke out, the country only had 8 military aircraft at its disposal, whereas Germany had 232, France had 138, Great Britain had 113, and Italy had 150.[16] The situation was aggravated by the fact Sweden

could not purchase state-of-the-art aircraft on the international market as a neutral and alliance-free nation.

At the dawn of World War II, Sweden found itself with insufficient numbers of military aircraft once again. It sought to address this deficiency by acquiring planes from other nations. Although Sweden had already paid for some of these aircraft, they were not delivered. For example, Sweden did not receive 300 aircraft from the United States, and France kept for itself the Breguet 694 airplanes that Sweden had ordered.[17]

These examples demonstrate the importance of self-sufficiency. Others cannot be counted upon to deliver desperately needed airpower assets in times of crisis. Having learned these lessons, in 1936 the Swedish government decided the Swedish Air Force should have a reliable aviation industry of its own. Consequently, Saab was founded the following year and eventually established itself as the nation's most important aerospace company.

Through these efforts, Sweden would eventually equip its airplanes with modern jet power, significantly increase the number of jet fighters at its disposal, and build its own Saab 32 Lansen aircraft. These developments contributed to the creation of the formidable Swedish Air Force of the 1950s, consisting of domestically built aircraft and ranked as the fourth largest air force in the world.[18]

Similarly, Israel underwent a revolution in the development of domestically produced military technology. It began manufacturing electronic countermeasures; decoys; combat aircraft; unmanned aerial vehicles; command, control, and communications; computers; intelligence systems; and standoff air-to-ground precision-guided munitions designed for the Israeli Air Force.[19] Such self-produced equipment greatly aided Israel in its struggles with preponderant adversaries during the Six Day War and the Yom Kippur War.

Yet it is unimaginable that the Israelis would have prevailed without the political, economic, and military support of the United States. Indeed, the United States provided Israel with aircraft, helicopters, munitions, radars, technical advisers, and sophisticated electronic systems when it suffered from critical shortages and outdated systems.

Furthermore, the addition of US fighter aircraft, such as F-15s and F-16s with look-down, shoot-down radars and new air-to-air missiles, turned the qualitative advantage in favor of the Israelis against the Arabs.[20] In summary, the Israeli case illustrates the significance of adequate self-sufficiency and external support for success as indicated by the Underdog's Model. Despite their importance, however, these factors are by themselves insufficient; the underdog also needs the commitment to prevail.

Commitment

Thomas Schelling, the 2005 Nobel Laureate in Economics, has written extensively on the art of commitment. He considers it essential to deterring an adversary and an obligation to one's future behavior with the purpose of influencing the choice of others.[21] Yet that is not how the concept is understood and adopted in the UM. In this framework, commitment refers to the level of devotion the belligerents demonstrate.

Indicators of commitment are (1) the public and soldiers' morale, (2) the proportion of total economic and military resources committed to the conflict, and (3) the number of military casualties a belligerent is willing to tolerate in relation to its population size. By outperforming its opponent in these areas, the underdog can compensate for some of its shortcomings.

North Vietnam and the Vietcong (NV/VC) managed to demonstrate this commitment in the armed struggle with the United States during the Vietnam War. For instance, studies suggest the US aerial bombing campaigns did not break the public or the NV/VC soldiers' morale as they continued to resist the foreign invader.[22] In 1966, then-US Secretary of Defense Robert S. McNamara stated, "if I had thought they [NV/VC] could take this punishment and fight this well, could enjoy fighting like this, I would have thought differently at the start."[23]

In contrast, the morale among the US public and troops was low as demonstrated by antiwar protests, insubordination, historically high levels of desertion rates, racial tension, and widespread drug abuse within the Air Force and the other branches.[24] In the midst of the Vietnam war, Colonel Robert D. Heinl Jr. wrote, "the morale, discipline, and battleworthiness of the US Armed Forces are, with a few salient exceptions, lower than at any time in this century and possibly in the history of the United States." [25] The NV/VC thus had a clear advantage over the United States in terms of morale.

Regarding resources, the means available to the United States dwarfed that of the NV/VC. Yet the NV/VC was willing to dedicate a much larger portion of its assets to the war effort. Indeed, sources claim the NV/VC drew on almost all its capabilities and made up for what it lacked in advanced weaponry with astonishing commitment.[26] Although the United States allegedly spent a whopping $200 billion on the war in Vietnam, this expenditure only accounted for a small proportion of its gross national product.

Moreover, even though the United States committed about 543,000 troops to the Vietnam War at most, and the USAF had 58,434 military personnel in South Vietnam at the war's peak, less than 25 percent of the US population was actually involved in this armed conflict.[27] In the words of former US Secretary of State

Colin Powell, "in Vietnam, we entered a halfhearted war, with much of the nation opposed or indifferent, while a small fraction carried the burden."[28]

Not only was the NV/VC willing to commit more of its resources to the war, but it was also more tolerant regarding casualties. Estimates suggest the NV/VC suffered about 1.1 million military casualties. Considering the entire communist population of Vietnam including the South was approximately 20 million during the war, the military losses alone accounted for 5.5 percent of that part of the population.[29] During the same period, roughly 58,000 US military members lost their lives, 2,538 of whom belonged to the Air Force.[30] These deaths amounted to about 0.03 percent of the total population of the United States at the time but was sufficient enough a statistic to prompt a withdrawal from the war in 1973 (the total population of the United States was about 212 million in 1973).

Hence, whereas a loss of 0.03 percent was enough to impel the United States to withdraw from the war, the NV/VC kept on fighting despite the fact it lost 5.5 percent of the communist population in military casualties alone. The difference in the number of military casualties the belligerents were willing to tolerate in relation to their respective population size was staggering.

On the whole, the evidence suggests the NV/VC's commitment to the Vietnam War was far greater than that of the United States in all three dimensions considered by the Underdog's Model. Jeffrey Record's investigation also suggests the astonishing commitment of the NV/VC was instrumental to its victory over the United States.[31]

Intelligence

Like commitment, intelligence is instrumental if a small force is to defeat a significantly larger force. Intelligence is defined as information of military value and is an activity that has occurred over the millennia in times of peace and war.[32] Sun Tzu focuses on intelligence gathering through espionage and establishes that "if you know the enemy and know yourself, you need not fear a hundred battles. . . . If you know neither yourself nor the enemy, you are a fool and will meet defeat in every battle."[33] Conversely, the Underdog's Model pays equal attention to intelligence denial and intelligence gathering and emphasizes all available intelligence disciplines including human intelligence, signals intelligence, imagery intelligence, measurement and signature intelligence, and open-source intelligence.

More specifically, the UM posits that the underdog's objective is to use all available means to acquire as much accurate intelligence as possible regarding the environment and their opponent's capabilities, objectives, strengths, weaknesses, and whereabouts. Without this vital intelligence, the underdog will be forced to operate blindly—a recipe for disaster. Since air operations are incredibly swift and

rapid changes may occur, the acquired intelligence must be up to date. Acting on obsolete information is futile. Furthermore, this intelligence must be interpreted correctly and acted upon wisely; otherwise, it is of little utility.

The validity of this point was apparent in the lead up to the 1973 Yom Kippur War. Before the Arab assault, Israeli intelligence obtained accurate information regarding vast troop concentrations on the Egyptian and Syrian fronts but wrongfully considered it a training exercise and therefore failed to anticipate the impending attack.[34]

At the same time, the underdog must limit its adversary's ability to collect intelligence. Hindering collection capabilities will cripple the antagonist's capacity to launch a successful campaign. This form of denial can be accomplished through camouflage, concealment, deception, and other means of footprint reduction. In peacetime, it is typically harder for democracies to effectively practice denial due to the relative transparency of such societies characterized by free media and legal restrictions. These legal impediments are usually relaxed in wartime. In contrast, authoritarian states are generally less inhibited from engaging in these denial operations due to their more secretive modus operandi.[35]

History is replete with examples where the underdog has obtained valuable information regarding their superior adversary. During the Vietnam War, the intelligence North Vietnam obtained regarding US aircraft movement, along with flight data and weather forecasts provided by the Soviet Union and China, allowed it to foresee US air strikes in several instances.[36] Likewise, North Vietnam identified and located US aircraft running low on fuel by monitoring the radio calls of US pilots and integrating this intelligence with its radar picture.[37] The North Vietnamese subsequently attacked these aircraft with their MiG fighters.[38]

The underdog can undertake various measures to conceal vital information from a powerful nemesis. Sweden sought to do this against the Soviet Union during the Cold War. Specifically, the Swedish Air Force developed dispersed and secret operating sites for launching air operations, with aircraft and crucial maintenance facilities hidden several miles away.[39] Also, the Swedish Air Force set up camouflage screens that were undetectable by existing sensors, and it employed decoys with the same radar readings, heat signatures, and visual identification markers as its jet fighters to delude the adversary regarding Swedish aircraft whereabouts.[40] Through these efforts, Sweden sought to deny its antagonist important intelligence concerning air operations and airpower assets.

In the case of open hostilities, the Soviet Union planned to circumvent these measures by sending special forces to kill Swedish aircrews before they had the chance to launch operations.[41] Consequently, success against a more powerful adversary requires sufficiently concealing aircraft and bases and protecting the

personnel necessary to operate the airpower assets. Maintaining secrecy in transparent democracies in an interconnected digital world where readily available data regarding the identity and potentially even the whereabouts of these individuals typically abound is easier said than done. Yet it is imperative to do so.

Dispersion and Concentration

The Underdog's Model also contends it is vital to adhere to the principles of dispersion and concentration that have preoccupied the minds of military thinkers such as Sir Basil Henry Liddell Hart. Although he considers concentration the main principle, Liddell Hart identifies dispersion as "an essential condition of survival and success on the guerrilla side, which must never present a target."[42] In contrast, dispersion is the main modus operandi in the UM, even though brief stints of concentration are considered imperative as well.

Due to its disadvantage, the underdog cannot afford major losses, and dispersal over space helps reduce the vulnerability of airpower assets. By spreading its forces, the underdog can deny the enemy the opportunity to neutralize a significant portion of its airpower assets simultaneously, thus avoiding a quick defeat. Simply put, dispersion helps minimize the damage the opponent may inflict. Such measures may also demoralize the foe if it finds it difficult to locate and destroy airpower assets. The level of dispersion that should be adopted depends on the particular campaign, terrain, and adversary the underdog faces.

Although dispersion is the general rule for the underdog, it must at times spatially concentrate its relatively limited airpower assets. Concentration can be utilized to attain favorable air situations or somewhat even the playing field against the mightier nemesis. Alternatively, a smaller concentration can be used to deceive the enemy of an impending attack in one area while the actual operation is launched elsewhere. Either way, the concentration should be brief, swift, and effective to take full advantage of the assembled strength. After the completion of the mission, the airpower assets should disperse again before the antagonist can concentrate its forces in response.

Sweden has long practiced the principle of dispersion. It built air bases in conjunction with existing highways and roads throughout its territory and constructed short-take-off-and-landing aircraft such as Saab 37 Viggen that can operate from these sites and use highways and roads as airstrips. As a result, Swedish airpower assets could be dispersed effectively across the nation. During the Cold War, the Swedish Air Force had reportedly approximately 30 large peacetime bases, as well as wartime bases and auxiliary bases that included a vast number of highways.[43]

Sweden established mobile logistics teams to travel between the dispersed locations for repair and maintenance work. The Viggen could be refueled and rearmed

in approximately 10 minutes, thus ensuring the productivity of this dispersal system.[44] Through these procedures, Swedish airpower assets could be scattered rapidly over a vast area, reducing the potential damage an adversary could inflict through area bombing.[45]

The Finnish Air Force employed dispersion and concentration with great effect during the Winter War when it was outnumbered by the Soviets, at times by a ratio of roughly 20 to 1. Despite these grim odds, the Finns managed to inflict major damage upon the Soviet Air Force while minimizing their own losses, partly due to their successful adaptation of dispersal and concentration tactics. Finland dispersed its aircraft to evade substantial losses, but once Soviet bomber formations were detected, the Finnish fighters concentrated and attacked them in large numbers. Finland's objective was to inflict as much damage on the Soviet bombers as possible before dispersing its fighters back to their respective bases.[46]

Engaging Vulnerable Military Targets

Targeting is at the heart of airpower theory. Douhet identifies target selection as "the most delicate operation of aerial warfare."[47] Similarly, Warden asserts "the key to air power is targeting."[48] The Underdog's Model concurs but distinguishes itself from their propositions concerning target selection.

Airpower assets typically cover a wide range and can strike targets over a vast area. The UM urges the underdog to employ these capabilities to engage vulnerable military targets—the weak spots of the enemy's military forces. These targets are identified and located through intelligence gathering, the fourth factor in the Underdog's Model. The selection of specific targets should be preceded by a cost-benefit analysis. The more critical the target is and the less costly it is to engage it, the more beneficial it is to attack it.

The model's insistence on vulnerable military targets puts it at odds with Clarke's SPOT paradigm that advocates the engagement of civilian targets as well.[49] Moreover, it is antithetical to Warden's five-ring model where the military forces are the least prioritized target group.[50] The Underdog's Model reverses this logic for two major reasons.

First, since military targets are considered legitimate in war, the underdog does not risk alienating potential supporters, turning the world opinion against itself, or legitimizing wide-scale counterstrikes by a more powerful adversary. Inversely, hitting illegitimate targets may strengthen the enemy's resolve to fight, impel it to dedicate more resources to the war, and escalate the ongoing struggle. That should be avoided. As such, Douhet's insistence on bombing the population is often a counterproductive strategy for the underdog since civilian targets are considered

illegitimate in contemporary warfare, and their engagement might provoke unwanted reactions.[51]

Second, by focusing on vulnerable military targets, the underdog can sustain its limited resources for longer. Attacks directed against the weak spots of the adversary's forces are less risky and decrease the odds of suffering substantial losses compared to assaults aimed at the rival's strengths. Avoiding losses is essential in an extended conflict with a preponderant enemy. Otherwise, the underdog risks a quick defeat.

Furthermore, successful strikes against the enemy's vulnerable military targets will enhance the will and determination of the underdog while raising costs for the rival and undermining its morale. Over time, the accumulated damage inflicted on the antagonist will reduce its strength and increase its war weariness. In general, the underdog wins by avoiding loss, and the longer the war endures, the higher likelihood that Goliath will deem the cost of defeating David too high and pull out as a result, as evidenced by the United States' withdrawal from Vietnam after years of fighting.

The Winter War also validates these assertions. At the onset, the USSR deployed 2,318 aircraft against Finland's 114 aircraft. On November 30, 1939, the Soviets dropped bombs over Helsinki causing international outrage and sympathy for the Finnish cause. For instance, the Swedish Voluntary Air Force—the Flight Regiment 19 or F-19—joined the ongoing struggle on the Finnish side against their Soviet adversaries.[52]

The Finns, on their part, avoided civilian targets and focused their efforts on legitimate vulnerable military targets. As such, they assaulted Soviet bombers and only targeted their more resilient fighters when deemed necessary. The strategy proved successful as Finland's Fokker aircraft managed to neutralize 34 Soviet aircraft in January 1940 alone.[53] Sources suggest the Finns shot down 240 Soviet planes in air combat, whereas USSR pilots only managed to neutralize 26 Finnish aircraft.[54]

Conclusion

The Underdog's Model, a theory of asymmetric airpower, explains how the underdog may succeed against a quantitatively and sometimes qualitatively superior opponent. According to this explanation, the outcomes of such encounters are predominantly determined by the combination of six factors: (1) creativity, (2) self-sufficiency and external support, (3) commitment, (4) intelligence, (5) dispersion and concentration, and (6) the engagement of vulnerable military targets. The UM maintains the better David performs vis-à-vis Goliath in these areas, the

higher likelihood it has of prevailing. The empirical evidence presented here supports these propositions.

Future studies should evaluate the utility of the Underdog's Model by subjecting it to rigorous testing and assess how well it fares compared to existing airpower theories such as Douhet's strategic bombing theory, Boyd's observe, orient, decide, act loop, Warden's five-ring model, Pape's theory of coercion, and/or Clarke's SPOT paradigm.

If these examinations lend further support for the UM, they will produce stronger incentives for underdogs to adopt the model to succeed in an asymmetric setting. For the UM to work in practice, a collective's individual members must embrace their responsibilities and contribute to accentuate the six overarching factors that the theory emphasizes. Only then can the shared tactical, operational, and strategic objectives of the underdog be attained and those of the adversary denied at the lowest cost possible—the hallmark of success. ✪

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Notes

1. Flight International, "World Air Forces 2021," FlightGlobal (website) accessed July 8, 2021, https://www.flightglobal.com/.

2. Alexander Boyd, The Soviet Air Force Since 1918 (New York: Stein and Day, 1977), 216; Lewis Edinger, "Sweden," in *Military Aspects of World Political Geography: Parts I, II, III, Air Science* 4, vol. 3, bk. 1 (Maxwell AFB, AL: Air University, Air Force Reserve Officers' Training Corps, 1954), 672; and Shmuel L. Gordon, "Air Superiority in the Israel-Arab Wars, 1967–1982," in *A History of Air Warfar*e, ed. John Andreas Olsen (Dulles, VA: Potomac Books, 2010), 127–56.

3. Shlomo Aloni, *Arab-Israeli Air Wars 1947–82,* Osprey Combat Aircraft 23, ed. Tony Holmes (Oxford: Osprey, 2001); Anders Annerfalk, *Flygvapnet 1926–1996: från Dronten till Gripen: flygvapnet 70 år den 1 juli 1996* (Ljungsbro, Sweden: Aviatic Förlag, 1996); Donald J. Mrozek, *Air Power and the Ground War in Vietnam: Ideas and Action* (Maxwell AFB, AL: Air University Press, 1988); and Christopher Francis Shores and Richard Ward, *Finnish Air Force, 1918–68,* Arco Aircam Aviation Series no. 14 (Oxford: Osprey, 1969).

4. John Andreas Olsen, ed., *Asymmetric Warfare* (Trondheim, Norway: Royal Norwegian Air Force Academy, 2002); Rod Thornton, *Asymmetric Warfare: Threat and Response in the 21st Century*, chap. 4 (Cambridge: Polity, 2007); Robin Higham, "Professional Note: Air Operations as Guerrilla Warfare," *Defense Analysis* 15, no. 2 (August 1, 1999); and John T. Farquhar, "Airpower and Irregular War: A Battle of Ideas," *Air & Space Power Journal* (*ASPJ*) 31, no. 1 (2017), https://www.airuniversity.af.edu/.

5. Bernard Cai Hanjie, "Air Power and Small States," *Pointer* 40, no. 2 (2014), https://www.mindef.gov.sg/.

6. Philip Sabin, "Air Strategy and the Underdog," in *Air Power 21: Challenges for the New Century*, ed. Peter W. Gray (London: Stationery Office, 2000), 69–98.

7. Shaun Clarke, "Small Nations and Asymmetric Air Power," in *Asymmetric Warfare*, Militærteoretisk skriftserie nr. 4, ed. John Andreas Olsen (Trondheim, Norway: Royal Norwegian Air Force Academy, 2002), 143–88; and Clarke, *Strategy, Air Strike and Small Nations* (Royal Australian Air Force Base, Fairbairn, Australia: Air Power Studies Centre, 1999), chaps. 7–8.

8. Dan Öberg, "Warfare as Design: Transgressive Creativity and Reductive Operational Planning," *Security Dialogue* 49, no. 6 (2018): 493–96, https://doi.org/.

9. George Domino and Marla L. Domino, eds., *Psychological Testing: An Introduction* (Cambridge: Cambridge University Press, 2006), 206.

10. Gregory J. Feist, "A Meta-Analysis of Personality in Scientific and Artistic Creativity," *Personality and Social Psychology Review* 2, no. 4 (1998), https://doi.org/; Missy Skurzewski-Servant, "Developing the Modern Leader: Integrating Creativity and Innovation in the Mentor–Protégé Relationship," *Journal of Leadership Studies* 10, no. 1 (2016): 89–90, https://doi.org/; Richard W. Woodman, John E. Sawyer, and Ricky W. Griffin, "Toward a Theory of Organizational Creativity," *Academy of Management Review* 18, no. 2 (1993), https://doi.org/; and Robert J. Sternberg, ed., *Handbook of Creativity* (Cambridge: Cambridge University Press, 1998), https://doi.org/.

11. Sebastian Cox and Peter Gray, eds., *Air Power History: Turning Points from Kitty Hawk to Kosovo*, Studies in Airpower (London: Frank Cass, 2002), 70.

12. Philip Kaplan, *Sailor, Battle of Britain Legend: Adolph Malan* (Barnsley, UK: Pen & Sword Aviation, 2012).

13. Kaplan, *Battle of Britain*.

14. Merfyn Bourne, *The Second World War in the Air: The Story of Air Combat in Every Theatre of World War Two* (Leicester, UK: Troubador, 2013), 30; and Kari Stenman and Kalevi Keskinen, *Lentolaivue 24*, Osprey Aviation Elite 4 (Oxford: Osprey, 2001), 122.

15. Ivan Arreguín-Toft, "How the Weak Win Wars: A Theory of Asymmetric Conflict," *International Security* 26, no. 1 (Summer 2001); and Jeffrey Record, *Beating Goliath: Why Insurgencies Win* (Washington, DC: Potomac Books, 2007).

16. Alan C. Wood and Alan Sutton, *Military Aviation of the First World War*: *The Aces of the Allies and the Central Powers* (Brimscombe, UK: Fonthill Media, 2016).

17. Arash Heydarian Pashakhanlou, "Swedish Air Power History: A Holistic Overview," *Air Power History* 65, no. 3 (2018): 11, https://www.semanticscholar.org/.

18. Pashakhanlou, "Air Power History," 9–12.

19. Gordon, "Air Superiority," 149.

20. Gordon, "Air Superiority," 131, 136–38, 149.

21. Thomas C. Schelling, *Arms and Influence* (New Haven, CT: Yale University Press, 2008).

22. Robert A. Pape, *Bombing to Win: Air Power and Coercion in War* (Ithaca, NY: Cornell University Press, 1996), 210.

23. Tom Wells, *The War Within: America's Battle over Vietnam* (Lincoln NE: iUniverse, 2005), 99.

24. Marilyn Young, "Ho, Ho, Ho Chi Minh Ho Chi Minh is Gonna Win!," in *Why the North Won the Vietnam War*, ed. Marc Jason Gilbert (New York: Palgrave Macmillan, 2002), 223; and Bernard C. Nalty, *Air War Over South Vietnam, 1968–1975* (Washington, DC: Air Force History and Museums Program, 2000), chap. 18.

25. Robert D. Heinl Jr., "The Collapse of the Armed Forces," *Armed Forces Journal*, June 7, 1971.

26. Record, *Beating Goliath*, 4; and Marc Jason Gilbert, "Introduction," in *Why the North Won*, 35.

27. Earl H. Tilford, "Preface," in *Why the North Won*; Andrew Mack, "Why Big Nations Lose Small Wars: The Politics of Asymmetric Conflict," *World Politics* 27, no. 2 (1975): 179–80; John T. Correll, *The Air Force in the Vietnam War* (Arlington, VA: Aerospace Education Foundation, 2004), 5; and James E. Westheider, The Vietnam War (Westport, CT: Greenwood Press, 2007), xxi.

28. Colin L. Powell with Joseph E. Persico, *My American Journey* (New York: Random House, 1995), 148.

29. Record, *Beating Goliath*; and John E. Mueller, "The Search for the 'Breaking Point' in Vietnam: The Statistics of a Deadly Quarrel," *International Studies Quarterly* 24, no. 4 (1980): 507, https://doi.org/.

30. Correll, *Air Force*, 25.

31. Jeffrey Record, "How America's Own Military Performance in Vietnam Aided and Abetted the 'North's' Victory,'" in *Why the North Won*, 133, emphasis added.

32. Arash Heydarian Pashakhanlou, "Intelligence and Diplomacy in the Security Dilemma: Gauging Capabilities and Intentions," *International Politics* 55, no. 5 (2018): 521, https://link.springer.com/.

33. Stan Taylor, "The Role of Intelligence in National Security," in *Contemporary Security Studies*, 1st ed., ed. Alan Collins (New York: Oxford University Press, 2007), 249.

34. Avi Shlaim, "Failures in National Intelligence Estimates: The Case of the Yom Kippur War," *World Politics* 28, no. 3 (1976), https://doi.org/; and Spencer C. Tucker, *Middle East Conflicts from Ancient Egypt to the 21st Century: An Encyclopedia and Document Collection*, 1st ed. (Santa Barbara, CA: ABC-CLIO, 2019), 819.

35. Roy Godson and James J. Wirtz, eds., *Strategic Denial and Deception: The Twenty-First Century Challenge* (New York: Routledge, 2002).

36. David Strachan-Morris, "The Use of Intelligence by Insurgent Groups: The North Vietnamese in the Second Indochina War as a Case Study," *Intelligence and National Security* 34, no. 7 (2019): 995, https://doi.org/.

37. Arash Heydarian Pashakhanlou, "AI, Autonomy, and Airpower: The End of Pilots?" *Defence Studies* 19, no. 4 (2019), https://doi.org/.

38. Marshall L. Michel III, *Clashes: Air Combat Over North Vietnam, 1965–1972* (Annapolis: Naval Institute Press, 2007), 234.

39. Richard Bitzinger, *Facing the Future: The Swedish Air Force, 1990–2005,* R-4007-RC (Santa Monica, CA: RAND Corporation, 1991), 24, https://www.rand.org/.

40. J. V. Ramana Rao, *Introduction to Camouflage and Deception* (New Delhi: Defence Research & Development Organisation, Ministry of Defence, 1999), 249; and J. R. Walker, ed., *The Future of Air Power*, RUSI Military Power Series (London: Ian Allan Limited, 1986), 73.

41. Gordon McCormick, *Stranger than Fiction: Soviet Submarine Operations in Swedish Waters* R-3776-AF (Santa Monica, CA: RAND Corporation, 1990), 24–25, https://www.rand.org/.

42. B. H. Liddell Hart, *Strategy* 2nd rev. ed. (New York: Meridian, 1991), 365.

43. Bitzinger, *Facing the Future*, 24; and Rudolf F. Christ, "Air Defense," *Military Review* 46, no. 8 (1966): 20.

44. Christ, "Air Defense."

45. Pashakhanlou, "Air Power History," 12.

46. Richard Hallion, "The Winter War," *Air Force Magazine*, September 1, 2012, https://www.airforcemag.com/.

47. Giulio Douhet, *The Command of the Air* (New York: Coward-McCann, 1942), 54.

48. John R. Glock, "The Evolution of Air Force Targeting," *ASPJ* 26, no. 6 (2012): 146, https://www.airuniversity.af.edu/.
49. Clarke, *Strategy, Air Strike*, 151.
50. John A. Warden, "The Enemy as a System," *Airpower Journal* 9, no. 1 (1995), https://www.airuniversity.af.edu/; and Arash Heydarian Pashakhanlou, "Decapitation in Libya: Winning the Conflict and Losing the Peace," *Washington Quarterly* 40, no. 4 (October 2, 2017), https://www.tandfonline.com/.
51. Douhet, *Command of the Air*.
52. Hallion, "The Winter War."
53. Hallion, "The Winter War."
54. Jonathan Clements, *Mannerheim: President, Soldier, Spy* (London: Haus, 2009), 251.

FEATURE

Department of Defense Laboratories

Recalibrating the Culture

Edie Williams

In his welcome message as the new Secretary of the Air Force, Frank Kendall noted that today, as it was during the Cold War, we are facing peer competitors that demand our attention to strategic and technical superiority.[1] Over the last three decades, the US military's focus on terrorism and low-intensity conflict pressured US science and technology (S&T) infrastructure and culture to concentrate on more mature technologies that could be rapidly transitioned to war fighters. For example, American scientists and engineers refocused on countering improvised explosive devices and other cheap, exploitable weapons of war.[2] The time has now come to recalibrate the Department of Defense (DOD) science and engineering workforce and investments back to strategic, complex, and sophisticated technology that will support twenty-first-century warfare.

Military innovation emerges from a combination of strategy and the means to execute that strategy.[3] Strategic and tactical advantages can be gained by a combination of terrain, location, speed, and the element of surprise supported by offensive and defensive weapons. These innovative advantages have been exploited for centuries, from ancient armies taking the high ground to the use of stealth aircraft by today's militaries.[4]

After World War II, the Department of Defense transformed the US military-industrial complex into a formidable force for military innovation focused on and supported by technology. Complimenting the military-industrial complex, the DOD laboratories evolved to concentrate on almost everything—from basic re-

search to advanced prototyping—with one goal: to achieve and maintain technical superiority.[5] This synergy gave the United States leadership in the defense research and development field for the next half-century.

During the decades following World War II, DOD laboratories coalesced around a Cold War mindset, trying to stay ahead of the Soviets by engaging in high-risk, high-reward, leap-ahead technology discovery and development.[6] After 1989, however, the emphasis shifted to the Middle East and terrorism.[7] While the enemy was innovative in its simplicity, the imperatives of the DOD laboratories changed to the rapid deployment of individual and small-unit technologies designed to counter terrorist threats such as handheld improvised explosive device detectors. The resources (funding and people) followed this shift as did the culture of technological risk-taking.[8]

As China emerges as a near-peer competitor and Russia continues its saber-rattling with technological advances in missile and space technologies, DOD labs should recalibrate from a near-term, terrorist mindset focused on rapid transition back to a more deliberate, threat-informed technology development process that supports great power competition with China and Russia. This recalibration will require more than just changing policies, redirecting priorities, and reallocating resources. An Edisonian mindset of risk and failure that leads to leap-ahead science and technology requires a fundamental shift in culture.[9] While funding is easier to reallocate, changing the culture is slow. Guiding that change will require thoughtful, deliberate actions by leaders in the DOD labs.

Changing Culture

Edgar Schein, a thought leader on organizational culture, noted culture is stable but not very malleable. Leaders create culture when they establish groups and organizations. After cultures exist, they determine criteria for leadership and thus determine who will or will not be a leader. But if elements of a culture become dysfunctional, it is the unique function of leadership to perceive the functional and dysfunctional elements of the existing culture. Leaders must manage cultural evolution and change in such a way that the group can survive in a changing environment.[10]

In June 2000, Navy research, development, test, and evaluation was beginning to see many of its labors finally come to transition with the introduction of the DD-21 Zumwalt-class Land Attack Destroyer.[11] Many S&T programs funded by the Office of Naval Research for decades were coming to life as advanced computing, multifunction radar, integrated propulsion systems, and new gun systems. But on September 11, 2001, everything changed. The S&T community ar-

rived back at work on the morning of September 12, 2001, focused on developing technologies rapidly to fight the new global war on terrorism.

From 2004 to 2016, supporting the war on terrorism subsumed nearly the entire focus of administration direction, congressional attention, and the priorities set for the DOD labs.[12] This "rapid acquisition-tech transition" mindset and the resource allocation decisions made by its leaders influenced the DOD lab workforce. Many scientists and engineers hired during this time never had the experience of the Cold War technoscientific arms race.[13]

Based on over 20 years in policy and program development in the DOD lab community and feedback from hundreds of scientists and engineers in the DOD lab enterprise, this article presents themes for leaders to consider if they want to change the culture in their organizations. These themes are focused on shifting cultures in the DOD labs from evolutionary-focused innovation with low-to-medium risk, to the pursuit of more revolutionary research and development (R&D), with medium-to-high risk. Such a shift produces leap-ahead innovation but can be useful for any leader interested in developing a healthy innovation culture in their organization.

Following Schein's model of culture (fig. 1), the article presents recommendations under themes offered in order of most to least malleable and shorter- to longer-term periods of change.

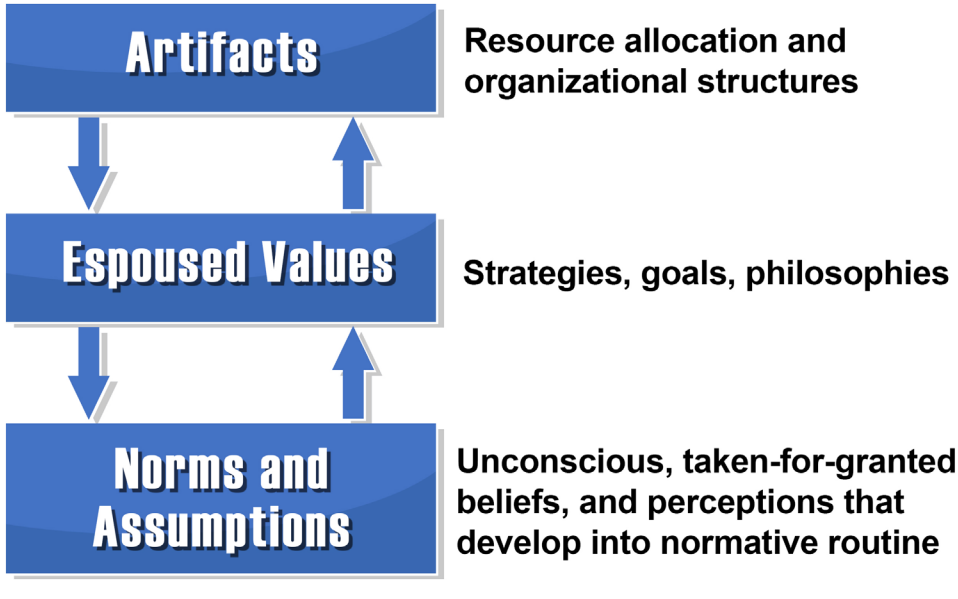

Figure 1. Adapted from Schein's body of work on culture

Resource Allocation and Organizational Structures

Organizational theorist Mary Jo Hatch extended Schein's theory by drawing on symbolic-interpretive perspectives around the leader's role in culture creation and change. In her view of cultural dynamics, strategy formulation is the manifestation of assumptions that underlie values and how those values point back to the assumptions. Championing the vision, goals, and objectives of an organization can be an effective communication tool for expressing underlying assumptions in the form of desired values.[14] Leaders show what they value by how they allocate their resources. Similarly, how they design their organizational structures shows their preferences for access, resource flow, and ultimately trust.

Under the theme of resource allocation and organizational structures, this article offers three recommendations. (1) Strategically allocate resources by connecting with the larger ecosystem to potentially leverage others' investments, thereby freeing more resources for higher-priority goals. (2) Fund more projects that seek the unknown, higher risk for higher-reward breakthroughs. (3) Allow multidisciplinary teams to form spontaneously—agile teaming—to inspire a spirit of collaboration.

Engage the Ecosystem

Historically, the United States dominated the R&D landscape, "funding as much as 69 percent of annual global R&D in the period following World War II."[15] While such funding in the United States has remained strong, the source of expenditures has shifted dramatically. Two sectors—business and the federal government—have together accounted for more than 90 percent of US R&D funding since 1953, though their combined share has fallen from a high of 98 percent in 1956 to 92 percent in 2016.

Federal R&D expenditures as a share of total US R&D expenditures peaked in 1964 at 66.8 percent, the same year that business R&D expenditures reached a nadir of 30.8 percent. Between 1964 and 2000, the federal government's share of expenditures fell and business's share rose: by 2000, research and development expenditures of business and the federal government, as percentages of total US R&D expenditures, accounted for 69.4 percent and 25.1 percent, respectively.

This shift in the composition of R&D funding resulted from faster growth in business R&D expenditures rather than a reduction in federal government R&D expenditures. From 2000 to 2010, business's share declined from 69.4 to 61.0 percent and has risen each year since, reaching an all-time high of 69.7 percent in 2018; from 2010 to 2018, the federal share declined from 31.1 to 21.9 percent.[16]

This data reveals federally-funded R&D is a smaller share of the total US research and development enterprise. This shift makes it imperative that DOD labs

reevaluate the apportionment of their limited R&D dollars and partner with business/industry counterparts and academic researchers, where appropriate, to synergize their investments by leveraging other R&D spending.

Before deciding with whom to connect, leaders should decide on their goals for connecting. The *US Air Force 2030 Science and Technology Strategy* directs the use of lead, leverage, and watch to support necessary organization and resourcing.[17] After determining the vision, mission, and goals, leaders in government R&D organizations typically align resources and organizational structures to mission-related scientific, research, or engineering topical areas. For basic and applied research, this is the point where lead, leverage, and watch principles should be incorporated.

A distinct advantage from the Cold War is the easy availability of advanced artificial intelligence tools and data analytics that can support leaders' decisions about where they should invest limited science and technology resources.[18] While many government S&T organizations use the lead, leverage, and watch paradigm for resource allocation, more can be done.

With the democratization of S&T in the past two decades, it is easier than ever before to watch and leverage research and technology globally. Once those decisions are made, leaders should ensure the free flow of that information to researchers by supporting information sharing in virtual and in-person environments. What remains is where the organization wants to lead. Leading in an area of S&T requires the right people, the best lab facilities, and a high risk tolerance.

Seek the Unknown

Government research and development organizations are constrained by planning and financial systems that impose structures to account for the expenditure of taxpayer dollars. Having determined S&T areas in which an organization wants to lead, leaders can shift resources accordingly. Creating resource flexibility to support S&T that seeks the unknown is difficult. Leaders must take deliberate and thoughtful actions to liberate resources (people and funding) in support of leading-edge science and technology. In a government lab, the best way to accomplish this is to create and fund program categories that are more general and wider in scope. Once those resources are made available, leaders should be careful not to add their own structural and process impediments to pursuing the unknown.

Encourage Spontaneous Teams

After leadership has determined their lead, leverage, and watch construct and created flexible funding structures to allow for the pursuit of leading-edge research, researchers will have the mandate and the resources needed to pursue their agen-

das. The final enabler of pursuing a breakthrough research agenda is collaboration across vertical, horizontal, stakeholder, demographic, and geographic boundaries.[19]

Some experts have noted that capability development starts with the convergence of multidisciplinary knowledge and teaming. "Combining new knowledge in materials science, nanotechnology, cognitive science, and human-machine interface technologies gave us the cell phone platform," a good example of convergence that "captures the synergism between multidisciplinary domains" and integrates them to support a new technology.[20]

Enabling the convergence of multidisciplinary knowledge can be accomplished either deliberately through matrixed organizational structures or less directly by opening avenues and encouraging collaboration and sharing of ideas and interests across organizational elements. Either way, collaboration of cross-disciplinary teams is a proven technique for enabling the pursuit of high-risk, high-reward science and technology.[21]

After considering these more malleable artifacts of culture, including resource allocation, organizational structures, and communication systems, leaders can turn to a level deeper in the culture—espoused values—to promote change. Values are difficult to change, but not impossible. Going back to Hatch, assumptions are manifested when the artifacts of culture are established, and the choices made point to the leaders' values.[22] The values behind the choices selected should be confirmed and reinforced with consistent messaging of decisions made and actions taken.

Walk the Talk

Modern leadership theories, including transformational leadership, authentic leadership, and servant leadership, hold that being transparent and consistent are positive traits.[23] Say what you will do, and do what you say. When promoting a culture change, message transparency and consistency acquire even more importance as conscious decisions can be undermined by seemingly unrelated actions that send a different message.

David Nadler and Michael Tushman developed a congruence model that illustrates how elements of organizations are connected. This model can be used to diagnose potential disconnects that might adversely affect transformational change efforts.[24] During the transformation process that occurs between inputs (environment, resources, history) and outputs (effects on individuals, groups, and organization), the model offers culture, organizational structure, work processes, and people's behaviors as checkpoints for incongruencies. Their findings indicate a successful transformation of the culture requires consistent policies and messages about work and mission, organizational structure, and opportunities for

people. The following three recommendations discuss ways to ensure innovation messaging and actions are consistent.

Allow Time for Innovation

One of the resources often taken for granted is people's time. Organizations and their leaders often talk about innovation and might also challenge people to be more innovative while at the same time burdening them with a seemingly unending list of administrative and programmatic duties and actions.[25] Allotting a specific time or amount of time per week for innovation can affirm a leader's commitment to their innovation rhetoric. Combined with collaborative tools, carving out time specifically for innovation can spark the multidisciplinary cross-pollination that allows a diversity of ideas and new ways of thinking.

Embrace Failure and Risk Taking

Thomas Edison is credited with the quote, "I have not failed 10,000 times. I have not failed once. I have succeeded in proving that those 10,000 ways will not work."[26] He understood that innovating is a series of creating, testing, and revising until the desired result is achieved. Throughout the process, learning takes place. Making pronouncements about greater risk-taking is not enough to change espoused values. A change in this level of culture requires a pattern of embracing and celebrating high-risk, high-reward innovation.

One way to celebrate failure and risk-taking is to plan an event or series of events where experienced researchers discuss their "Edison experiences"—when they engaged in the pursuit of a result that eluded them. Other stories from basic researchers might involve failures that turned into valuable knowledge leading to other breakthroughs, like the popularized 3M Post-It note example.[27] Many less popular examples involve pharmaceuticals. One such case is Iproniazid, which was being developed as a treatment for tuberculosis. While it failed as an effective treatment of tuberculosis, Iproniazid became the first marketed treatment for depression.[28] These types of events can also lead to cross-disciplinary collaboration and mentoring opportunities.

Risk-Taking and Innovation as Measures of Effectiveness

The DOD labs experience innovation dissonance in two areas: resource incongruence and performance evaluation. Both challenges create opportunities for leaders to show they value greater risk-taking by making the right resources available and rewarding high-risk, high-reward innovation.

Corporate R&D can take two forms—the evolutionary improvement of products or more revolutionary innovation that takes the product in a different direction or to a higher level of functionality. In the case of revolutionary innovations, risk is managed by calculating the return on investment. Will the customer be willing to pay $X more for Y improvement? A good example of this is adaptive headlights. The precursor to adaptive headlights was the idea of swiveling headlights on the 1948 Tucker sedan.[29] In the late 1990s, what we now know as adaptive headlight technology was developed, but a decade passed before automobile manufacturers achieved an acceptable return on investment for introducing this technology into their production vehicles.[30]

While government research and development does not have the same return-on-investment restrictions as corporate R&D, it faces the formidable challenge of transition. With the focus in recent decades on combatting terrorism, the science and technology community has been pressured to find transition mechanisms earlier in the technology development process. This "transition creep" has affected resource allocation by encouraging activities funded as applied research with higher risk to focus more on advanced technology development where risk is reduced.[31] Consequently, researchers are pressed to achieve higher levels of technology readiness toward transition with resources that should be used to pursue projects with more risk.

A second area incorporating risk into measures of effectiveness is personnel evaluations. Regardless of the profession, personnel evaluations focus primarily on success. In the laboratory culture, success might mean a transition of technology, publishing of successful experiments, or awards won for successful projects. Celebrating failure and risk-taking are not themes ordinarily seen in military or civilian personnel evaluations in DOD labs. Aligning leaders' desires for high-risk, high-reward innovation with advancement-worthy personnel evaluations will take time and effort. Military and civilian research community standards must be addressed and adjusted to ensure that engaging in higher-risk innovation is rewarded.

Provide Escape Routes

The final area of culture to be addressed is normative orientation, the least malleable and slowest to change. Norms are unconscious beliefs, perceptions, and attitudes that develop into patterns of behavior. Changing norms requires a long-term commitment and constant communication to manage the often uncomfortable shift in the way people think and behave in reaction to these changes.

The concept of structuration describes the process wherein norms are developed and communicated to the members of organizations. It is a reciprocal process of meaning-making at the organizational level.[32] Structuration is further

defined as "explicit actions (e.g., setting boundaries, physical interaction, organization of work, social status, rules, leadership) and implicit guiding social patterns (e.g., norms, values, traditions, culture)." These actions and patterns allow individuals to make meaning of their experience; instill integrity through normative orientation, including sanctions for violating norms; and bring order through power and control.[33] Said much more simply, norms are the invisible boundaries that cause people to act in certain ways.

Noted social and organizational science pioneer Kurt Lewin believed changing culture entailed a three-stage process—unfreeze, change, and refreeze.[34] Unfreezing cultural norms is easier said than done. A new organization chart can be drawn, new seating arrangements can be made, and even new policies and procedures can be issued, but changing norms or behavioral patterns, requires deviation. Said another way, if norms are the invisible wall, leaders must provide escape routes over, under, or through cracks in the wall.[35]

The following recommendations are exit routes leaders can provide or allow so people can begin to change behavioral patterns and ultimately their beliefs about the organization's commitment to innovation and greater tolerance for risk.

Encourage Personnel Exchanges

A long-standing practice that ebbs and flows in application is personnel exchanges between government, industry, and academia. The benefits of these exchanges are numerous, but the one most pertinent to this discussion is cultural transfer. Anthropological studies show that when a person goes from one culture to another, they bring along certain artifacts, habits, and routines.[36] Inevitably when they return, the process is repeated. For this reason, sending a government civilian to a business perceived to be more innovative has become increasingly popular.

With this in mind, an opportunity exists in the DOD labs that has not been fully explored. Personnel exchanges within the DOD lab, between DOD labs, with other federal agencies (e.g., National Aeronautics and Space Administration and Department of Energy labs), and with others in the ecosystem (e.g., federally funded research and development centers and university-affiliated research centers) provide other opportunities to cross-pollinate cultures.

Flip the Script

Another escape route that can unfreeze and change behavioral patterns is to change perspectives. Tangibly, this might mean empowering bench scientists to perform a task usually reserved for leadership. In a current example, a senior leader

elected to give a group of bench scientists the task of developing the basic research agenda for the organization, a task normally reserved for senior leaders.

Several benefits will likely arise from this action. First, perspectives of the bench scientists will change as they realize how difficult and daunting the task is of betting on the future with the nearly unknown portfolio of science. Second, the inexperienced individuals will learn valuable lessons working together as a group. Action learning in this instance provides participants an opportunity to use self-reflection and learn from each other while engaging in problem-solving and decision-making processes.[37] Finally, changing perspectives will be an opportunity for coaching and mentorship, including reciprocal communication between leaders and bench scientists.

Sink or Swim

The final recommendation for kickstarting a change in norms toward a more innovative culture is a combination of almost everything discussed to this point. In the same way that a bird pushes its offspring out of the nest, giving a bench scientist full autonomy to run a research project is perhaps the truest sign of walking the innovation talk. Allocating enough resources and allowing a bench scientist to choose the location, facilities, and their research team sound like an extravagance, but DOD labs give millions of dollars each year to external research organizations with the same autonomy. Breaking that norm by giving internal scientists and engineers the same autonomy imparts the trust that is the bedrock of any healthy culture, and more importantly, a vibrant innovation culture.

Conclusion

The United States has always maintained an edge in creativity. Turning that creativity into innovation has been the hallmark of US domination in commercial and military innovation. The current and future complexity of the national security environment is defined by the increasing pace and globalization of technology development, fragile system-of-system dependencies that are vulnerable to attack, and new domains of military conflict such as space and cyberspace that require new S&T investment under constrained budgets.

This complexity and the increasing technological threats from China and Russia demand a recalibration of how the DOD labs think about innovation and risk as they engage in the exploration of science and development of technology. A culture of creativity and scientific adventurism fueled by greater risk tolerance and learning from failure might be the key to attracting and retaining the DOD lab workforce of the future.

This analysis of organizational culture with specific recommendations for refocusing the culture in the DOD labs is formulated for leaders in those labs and other organizations to consider as they continue to carefully navigate the increasingly complex research and development landscape of the twenty-first century. ✪

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Notes

1. Frank Kendall, Secretary of the Air Force welcome message, July 28, 2021.
2. George W. Bush, *National Strategy for Combating Terrorism* (Washington, DC: The White House, 2006), https://2001-2009.state.gov/.
3. Carl von Clausewitz, *On War*, ed. and trans. J. J. Graham (Ware, England: Wordsworth Classics, 1997).
4. Edie Williams and Alan R. Shaffer, "The Defense Innovation Initiative: The Importance of Capability Prototyping," *Joint Force Quarterly* 77 (April 2015), https://ndupress.ndu.edu/.
5. Department of Defense (DOD) Defense Science Board Task Force on Defense Research Enterprise Assessment, *Defense Research Enterprise Assessment* (Washington, DC: DOD, January 2017), https://dsb.cto.mil/.
6. Michael J. Nickels, "U.S. Collaborative-Engagement with China: Using Strategic Technological Collaborative Leadership (STCL)" (master's thesis, Naval Postgraduate School, March 2008), https://apps.dtic.mil/.
7. Bush, *Combating Terrorism*.
8. Robert L. Burhrkuhl, "Rapid Acquisition: When the Warfighter Needs It Now," *Defense AT&L Magazine* (November–December 2006), https://www.dau.edu/library/.
9. James M. Utterback, *Mastering the Dynamics of Innovation* (Boston: Harvard Business School Press, 1996).
10. Edgar H. Schein, *Organizational Culture and Leadership*, 5th ed. (Hoboken, NJ: Wiley, 2017).
11. Author's firsthand experience serving as the program sponsor for the Navy RDT&E appropriation and executive assistant to the chief of naval research.
12. Based on the author's experience as assistant secretary of Defense for Research and Engineering from 2004 to 2018.
13. Naomi Oreskes and John Krige, eds., *Science and Technology in the Global Cold War* (Cambridge, MA: MIT Press, 2014).
14. Mary Jo Hatch, *Organization Theory: Modern, Symbolic, and Postmodern Perspectives* (Oxford: Oxford University Press, 2018).
15. US Department of Commerce (DOC) Office of Technology Policy, *The Global Context for US Technology Policy* (Washington, DC: DOC, 1997), https://usa.usembassy.de/.
16. Congressional Research Service (CRS), "U.S. Research and Development Funding and Performance: Fact Sheet" (Washington, DC: CRS, January 24, 2020), https://sgp.fas.org/.
17. US Air Force (USAF), *U.S. Air Force 2030 Science and Technology Strategy: Strengthening USAF Science and Technology for 2030 and Beyond* (Washington, DC: USAF, 2019), 16, https://www.af.mil/Portals/.

18. CRS, *Artificial Intelligence and National Security*, R45178 (Washington, DC: CRS, November 10, 2020), https://sgp.fas.org/.

19. Chris Ernst and Donna Chrobot-Mason, *Boundary Spanning Leadership: Six Practices for Solving Problems, Driving Innovation, and Transforming Organizations* (New York: McGraw-Hill, 2010).

20. Williams and Shaffer, "Defense Innovation Initiative."

21. Mihail C. Roco et al., eds., *Convergence of Knowledge, Technology, and Society: Beyond Convergence of Nano-Bio-Info-Cognitive Technologies* (Lancaster, PA: World Technology Evaluation Center, 2013).

22. Schein, *Organizational Culture*.

23. Ronald H. Humphrey, *Effective Leadership: Theory, Cases and Applications* (Washington, DC: SAGE, 2013).

24. David A. Nadler and Michael L. Tushma, "A Model for Diagnosing Organizational Behavior," *Organizational Dynamics* 9, no. 2 (Autumn 1980), https://www.sciencedirect.com/.

25. Michael Chui, "How Big Companies Innovate," McKinsey & Company, February 1, 2015, https://www.mckinsey.com/.

26. Nathan Furr, "How Failure Taught Edison to Innovate," *Forbes*, June 9, 2011, https://www.forbes.com/.

27. Robert B. Rosenfeld, Gary J. Wilhelmi, and Andrew Harrison, *The Invisible Element: A Practical Guide for the Human Dynamics of Innovation* (New York: Innovatus Press, 2011), 80.

28. Richard F. Celeste, Ann Griswold, and Miron L. Straf, eds., *Furthering America's Research Enterprise: Committee on Assessing the Value of Research in Advancing National Goals* (Washington, DC: National Academies Press, 2014), https://www.nap.edu/.

29. "Preston Tucker and the Tucker 48," Henry Ford Museum of American Innovation, accessed October 8, 2021, https://www.thehenryford.org/.

30. Snehal Parhad, "Design and Implementation of Adaptive Front Lighting System," *International Journal of Engineering Research and Technology* 3, no. 2 (February 2014), https://www.ijert.org/.

31. Celeste, Griswold, and Straf, *America's Research Enterprise*.

32. Anthony Giddens, *The Constitution of Society: Outline of the Theory of Structuration* (Los Angeles: University of California Press, 1986).

33. David R. Schwandt, "Individual and Collective Coevolution: Leadership as Emergent Social Structuring," in *Complexity Leadership: Part 1: Conceptual Foundations*, ed. Mary Uhl-Bien and Russ Marion (Charlotte, NC: Information Age, 2007), 101–28.

34. Edgar H. Schein, "The Individual, the Organization, and the Career: A Conceptual Scheme," *Journal of Applied Behavioral Science* 7, no. 4 (July 1971), https://doi.org/.

35. Tong Zhang, "Give Your Team the Freedom to 'Wander' and Innovation Will Flow," Fast Company, July 20, 2021, https://www.fastcompany.com/.

36. Jaan Valsiner, "Culture and Its Transfer: Ways of Creating General Knowledge through the Study of Cultural Particulars," *Online Readings in Psychology and Culture* 2, no. 1 (February 1, 2003), https://scholarworks.gvsu.edu/.

37. Michael J. Marquardt, *Optimizing the Power of Action Learning: Real-Time Strategies for Developing Leaders, Building Teams, and Transforming Organizations*, 2nd ed. (Mountain View, CA: Davis-Black Publishing, 2011).

Integrating Cost as a Decision Variable in Wargames

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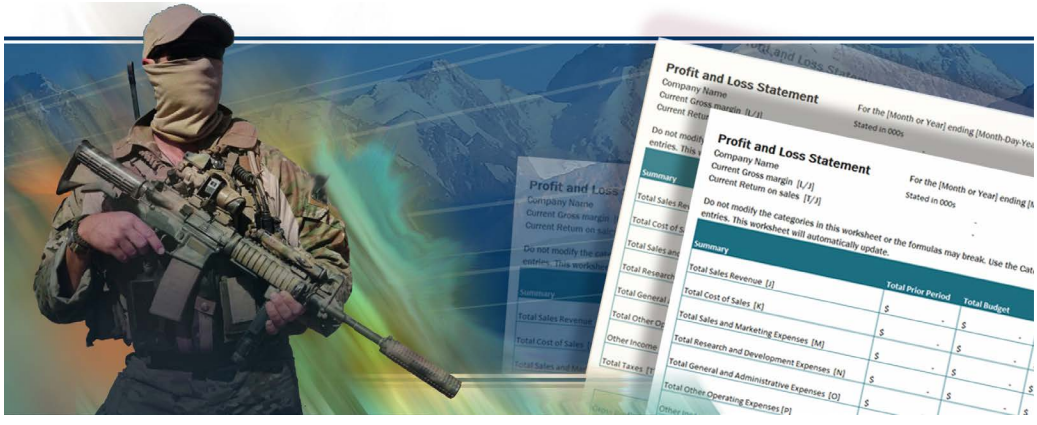

The US military can no longer afford to be reactive, leaving critical cost analyses to the months and years following operations or full-scale conflicts. By leveraging cost in wargaming, as part of the Joint planning process, the Department of Defense (DOD) can provide Congress and the American taxpayers a range of potential costs associated with various military engagements. If senior leaders can consider costs as part of effectiveness analyses during wargames, they can provide more fully informed decisions reflecting fiscal and operational realities.

Resilient and Agile Logistics

Wargames serve a critical function in preparing the United States Air Force (USAF) for future wars and conflicts. They immerse decision makers in a realistic environment in which wartime decisions are tested. Data from stress tests of feasibility, current concepts of operations, risks of innovative design solutions, and other effectiveness measures provide decision makers the necessary information to enable the military to stay ahead of its adversaries.[1]

Achieving these desired outcomes requires robustness and realism in the simulation. The 2018 Task Force on Survivable Logistics found that one element of

realism—logistical constraints—was lacking in wargames.[2] In its findings, the task force recommended the military departments develop new integrated wargames "with the logistics fidelity to identify logistics constraints to operations."[3]

The 2018 *National Defense Strategy* provides additional evidence regarding the importance of resilient and agile logistics, calling DOD investment imperative.[4] One way the Air Force is addressing these needs is through the development of the Integrated Sustainment Wargaming and Analysis Toolkit (ISWAT). The goal of the toolkit is to provide defensible, long-duration logistics and sustainment wargames and analyses. While ISWAT fills the previously identified logistics wargaming gap, the current version lacks fiscal considerations to create the realistic environment senior leaders need to make fully informed decisions.

Incorporating cost as a factor in evaluating wargame outcomes is a novel change to the current state of wargaming. Why are costs important? As John G. Vonglis, former Assistant Secretary of the Air Force (Financial Management and Comptroller) stated, "in a constrained fiscal environment, our ability to provide accurate, timely, and relevant financial data, from cost estimates to budget projections . . . is paramount to enabling Air Force leadership at all organizational levels to make informed decisions."[5] To be clear, this article does not suggest cost should be the primary decision criterion. Rather, senior leaders' consideration of cost in conjunction with effectiveness analysis provides the ability to make more fully informed wargame decisions.

This article explains how to integrate cost as a decision factor into a wargame platform using the ISWAT platform as a proof of concept. But incorporating costs into ISWAT does not come without complications. For example, the Department of Defense does not have an approach to estimating wartime flying-hour costs. Rather, flying-hour costs are calculated under an assumption of peacetime. This approach is problematic as prior research suggests wartime and peacetime costs differ.[6]

Thus, to fully develop credible cost models for ISWAT, several questions must be answered: (1) Which cost elements are relevant to wargame scenario modeling? (2) Which cost elements vary based on wartime engagement, and how can this variation be modeled? and (3) How can cost be compared relative to effectiveness in wargaming? This article seeks to answer these questions by examining the development of cost models for the ISWAT wargaming platform, the results of which serve as a road map for incorporation in other USAF wargaming efforts.

History of Wargaming

While wargaming has its roots in traditional games such as chess and Go, modern wargaming was not introduced until the 1800s. Just as Prussian general

Baron von Steuben introduced drill and ceremony to the United States at Valley Forge, Prussia is also credited with introducing the United States to wargaming.[7] Modern wargaming is generally considered to have been developed by Prussian nobleman George Leopold von Reisswitz in 1811, and further refined by his son, George Heinrich Rudolf Johann von Reisswitz—an officer in the Prussian army—in 1824.[8] This game, titled *Kriegsspiel*, was subsequently translated into English and adapted to US war strategy by Major W. R. Livermore in 1833.[9] Modern wargames have developed substantially since this point; however, much of the published research tends to focus on specific scenarios or on the development of new models such as the defense of the Baltics, defense of the homeland, or next-generation war-gaming for the US Marine Corps.[10]

Generally, the literature lacks research accounting for additional variables in wargames. One notable exception, as previously discussed, is the recent incorporation of agile logistics as a focus of the ISWAT wargame. Several prior research efforts have supported the development and incorporation of logistics into ISWAT.[11] These efforts have identified cost and budgets as important factors that *should* be considered in the logistics wargame, but thus far no specific cost research *has* been produced.

The omission of cost as a consideration in wargames is nearly ubiquitous. A literature review found only one mention of "cost of war" being included in wargames. This occurred in the 1960s, championed by then-Secretary of Defense Robert S. McNamara, whose goal was to achieve effective defense at a sustainable cost point.[12] Thus, the inclusion of cost as a decision factor in wargames provides a unique contribution to the current wargaming body of knowledge.

Analysis Tactics and Decision-Making Protocol

The first step in including costs in wargames is determining which aspects of the wargame are relevant and should be costed. While this step may seem trivial on the surface, the practical application is quite difficult. The universe of potential cost elements includes not only the obvious candidates such as fuel or aircraft maintenance, but also buildings, personnel casualties, and runway repair. Additionally, reasonable arguments to include or exclude crew manpower can be made. One could argue we pay for the manpower regardless so it should be excluded, but crew manpower is also a direct cost incurred during the wargame so the argument for inclusion is equally compelling.

To resolve these conflicts, ISWAT subject matters experts were brought in to identify those costs deemed most relevant. To guide the decision-making process, the team focused on operating and support (O&S) and manpower costs characterized by variability based on wargame decisions. Through these discussions, five

major cost categories were identified as critical: aircraft operations, fuel, munitions, unexploded ordnance (UXO) removal, and runway damage repair. A brief explanation of the cost methodology for four of these elements is provided below. (Fuel as a cost category is straightforward.)

Aircraft Operations

Aircraft operations represent the largest costs not only in ISWAT but in most Air Force wargames. The Office of Cost Assessment and Program Evaluation (CAPE) publishes a standard cost element structure (CES) the Air Force utilizes to collect and organize O&S data.[13] Each element of the CAPE CES was analyzed in conjunction with inputs from Air Force Materiel Command's Directorate of Strategic Plans, Programs, Requirements, and Assessments (A5/8/9) SMEs to identify the specific elements relevant to wargames. Table 1 contains a list of these cost elements and their inclusion or exclusion (italic elements are excluded; bold elements are included). Additionally, the data source and a brief description of the methodology are provided for each element.

Table 1. CES inclusion/exclusion and methodology overview

CES	Data Source	Reason For Exclusion/Methodology
1.0 Unit-Level Manpower	N/A	N/A
1.1 Operations	AFI 65-503 Table A36-1	Multiply Aircrew, aircrew ratio, FY 2020 Composite Rate, FY 2020 Hourly Rate
1.2 Unit-Level Maintenance	LCOM	Manpower requirements by rank per aircraft times FY 2020 Composite Rate, FY 2020 Hourly Rate
1.3 Other Unit-Level	N/A	Includes support costs, we focused on operational costs
2.0 Unit Operations	N/A	N/A
2.1 Operation Material	N/A	N/A
2.1.1 Energy (Fuel)	AFI 65-503 Table A13-1/DLA	Multiply hourly consumption by DLA JP-8 fuel cost
2.1.2 Training Munitions and Expendable Storage	N/A	Training munitions non-differentiable from expendable stores
2.1.3 Other Operational Material	N/A	No specified costs, misc catch all
2.2 Support Services	AFTOC	3 year historical average divided by flight hours
2.3 Temporary Duty	N/A	TDYs typically do not occur during deployments
2.4 Transportation	AFTOC	3 year historical average divided by flight hours
3.0 Maintenance	AFI 65-503 Table A4-1	Given vales for GSD, MSD, and CLS plus wartime cost increase

Table 1. (*continued...*)

CES		Data Source	Reason For Exclusion/Methodology
3.1	**Consumable Materials and Repair Parts**	N/A	Included in 3.0
3.2	**Depot Level Reparables**	N/A	Included in 3.0
3.3	**Intermediate Maintenance (External to Unit-Level)**	N/A	Included in 3.0
3.4	**Depot maintenance**	N/A	Included in 3.0
3.5	*Other Maintenance*	N/A	Included in 3.0
4.0	Sustaining Support	N/A	N/A
4.1	*System Specific Training*	N/A	Costs incured regardless of wartime engagement
4.2	**Support Equipment Replacement and Repair**	AFTOC	3 year historical average divided by flight hours
4.3	*Sustaining/Systems Engineering*	N/A	Costs based on age of aircraft and not usage rate
4.4	**Program Management**	AFTOC	3 year historical average divided by flight hours
4.5	**Information Systems**	AFTOC	3 year historical average divided by flight hours
4.6	**Data and Technical Publications**	AFTOC	3 year historical average divided by flight hours
4.7	*Simulator Operations and Repair*	N/A	Costs associated with training only
4.8	*Other Sustaining Support*	N/A	Costs not tied to a specific element
5.0	*Continuing System Improvements*	N/A	Costs not driven by wartime engagement
6.0	*Indirect Support*	N/A	Not direct system costs

With the relevant aircraft cost elements identified, the team then determined a wartime cost of operation. Previous literature found operational costs during wartime vary from peacetime, but the literature failed to recommend methodologies to calculate these costs at the CES level.[14] One solution would have been to identify a true deployed cost per flying hour by dividing the deployed cost by the number of deployed flying hours. But while deployed costs are easily obtainable, the Air Force does not formally track associated deployed flying hours in an unclassified centralized repository.

The solution to this problem was to derive a wartime cost by analyzing aircraft operating costs before 9/11 in comparison to costs after 9/11. First, the team reviewed the data and saw a large spike in operating hours in 2002 and 2003 compared to prior years, indicating the hypothesis of a pre- to post-9/11 change due to wartime had merit. The team verified this conclusion through statistical testing.

Next, the team utilized regression analysis to identify the difference in cost between peacetime and wartime flying hours. More specifically, the team employed regression analysis on O&S data from the Air Force Total Ownership Cost database where the fiscal years 1999–2001 were considered analogous to peacetime, and the fiscal years 2002–03 were analogous to wartime. These regression results provided a dollar value that was added to the relevant cost elements in table 1.

One of the largest benefits of using the CAPE CES in the methodology was the ability to tailor the analysis. By delineating costs at the lowest level possible, costs could be included or excluded with great granularity. This specificity allowed for a large degree of flexibility in wargame cost analysis. In initial tests of this ISWAT cost model, senior leaders requested "what-if" analyses examining only so-called marginal costs, defined as those CES elements from table 1 that represented only the expendable items from the wargame. Through discussion with SMEs at Air Force Materiel Command A5/8/9, the relevant CES elements (CES 2.1.1 *Fuel* and CES 3.0 *Maintenance*) were identified and calculated as marginal costs. While this represents only one example, the flexible structure of this method allows for numerous future "what-if" scenarios.

A second example of this flexibility is the comparison of use rates of aircraft employed in the wargame with aircraft not used in the scenario. This analysis also came from discussions with senior leaders during the early testing of the cost model. The purpose of this analysis was to attribute cost only to those hours accrued during the wargame that exceeded hours operated if the wargame had not occurred. The team obtained this specific data by multiplying the number of wargame days by the peacetime cost per flying hour of the aircraft and the average number of hours used per day. The wargaming cost of the aircraft was then subtracted.

Additionally, this method can be used to gauge if deployments to the theater are appropriately sized. If use rates are substantially lower than those at home stations, it follows that assets may be at increased risk of destruction due to aircraft spending more time on the ground.

One last example of the flexibility this methodology affords is in transportation costs. The transportation costs (CES 2.4 *Transportation*) were calculated on a per total flying hour basis; however, they could also be calculated based on the resupply rate. Since ISWAT generates a time-phased force deployment document for supplies needed, pallet positions, and required aircraft for transport, transportation costs can be calculated by multiplying aircraft flying hours for supply missions by the calculated wargame cost per flying hour.

Munitions

Munition costs are an obvious expense associated with wartime engagement, but components of munition costs are quite different from those of an aircraft. Whereas aircraft have a large O&S cost, munitions do not. Rather, the procurement cost of munitions expended in the wargame is of interest. Therefore, the team utilized the average procurement unit cost metric as its calculation. Average procurement unit cost is the total procurement cost divided by the number of units employed in the wargame. This calculation removes any O&S or indirect costs and represents what it would cost to replace a weapon after its employment.

Data sources to calculate munition average procurement unit costs were not as readily available as aircraft operational data. To the maximum extent possible, authoritative DOD sources were used, and selective acquisition reports were the primary sources. In those instances where selective acquisition reporting was not required for the munition program or not available for a munition, the team obtained information directly from the specific munition program office. These data came in the form of recent cost estimates, but due to unavailability, some average procurement unit costs had to be collected from non-DOD sources such as Defense Industry Daily.

Unexploded Ordnance

A less obvious cost of wartime engagement is the cost of UXO removal. Unexploded ordnance removal was calculated in two parts—equipment costs and manpower costs. Equipment costs were calculated by the composition of unit type code equipment lists and use rates provided by explosive ordnance disposal SMEs. The unit type code equipment consisted of items such as time blasting fuses, blasting caps, and shock tubes. Manpower costs were calculated based on the average composition of two explosive ordnance disposal unit type codes.

Runway Repair

Another important cost in wargames is runway repair. The basis of cost for this element is the Rapid Airfield Damage Recovery system. Rapid airfield damage recovery simultaneously performs as many runway repair functions as possible. While these repairs are rapid, they are not permanent. Each repair can handle a different number of total takeoffs and landings (e.g., 100 or 3,000).[15] For ISWAT analysis, the team calculated an average of these repair types (100 and 1,000 takeoffs/landings) as the basis for cost. The costs for runway repair were calculated in three categories: materiel, fuel, and manpower. Equipment costs are excluded, as these costs are applicable across multiple wargames.

Cost and Mission Effectiveness Tradeoff

Once a wargame is completed, important insights can be garnered through the postgame analysis. The cost models presented in this article are intended to be used primarily in this phase of the wargame. While cost is directly measurable, the measures of effectiveness are designed to support the decisions of a senior leader during a wargame and can be measured by different metrics.[16] To investigate the relationship between overall wargame cost and effectiveness, the data were plotted on a graph with cost on the x-axis and effectiveness on the y-axis. The team then overlaid on the x-axis a stacked bar chart with a section of each column for the major cost categories. The analysis of this graph was also aided by the inclusion of a threshold and objective effectiveness line. An example of this graphic using notional data is shown in figure 1.

This variability in effectiveness measures provides flexibility to tailor the wargame to the specified objectives of each unique wargame and can be applied in future wargames at the tactical level, evaluating the use of an individual weapon system. In the case of figure 1, the F-35 has been drawn out as a section of aircraft costs. If there was an option to use the lower-cost F-16 instead of the F-35 for some of or all these hours, the outcome of potential cost savings on effectiveness can be analyzed.

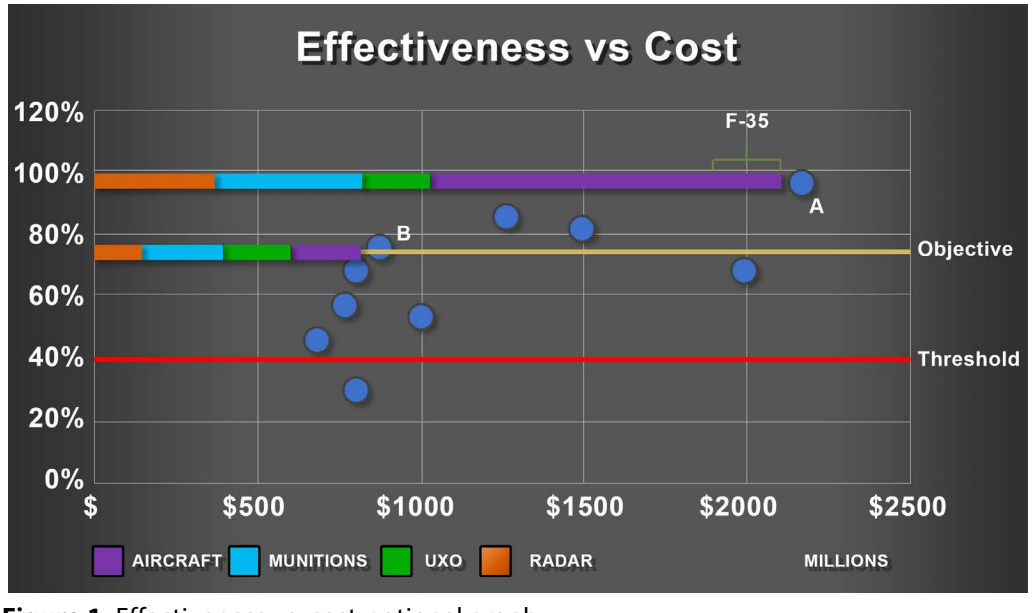

Figure 1. Effectiveness vs. cost-notional graph

Additionally, wargames can be compared to each other at a strategic level. For those points that fall above the yellow objective line, the wargames were consid-

ered effective. But bringing cost into the equation may result in the outcome being viewed differently. For example, as shown in figure 1, the most effective outcome (96 percent) costs $2.2 billion (Point A). The objective effectiveness (75 percent) could have been achieved at a cost of only $0.7 billion (Point B). The decision maker can then decide whether the additional $1.5 billion is worth the additional 26 percent of effectiveness.

Those points falling between the red threshold line and the yellow objective line provide another opportunity for analysis. These points represent wargame decisions that met a minimum effectiveness standard but fell short of the effectiveness target. Points that fall in this region should be analyzed to find the most cost-effective decision. Those points that fall below the red line represent wargaming decisions that most likely missed the intent of the wargame and can thus be discarded from the trade-off analysis.

Changes to the status-quo mode of operation often require a crisis or watershed event. Recent wargaming events are providing that window of opportunity. Vice Chairman of the Joint Chiefs of Staff General John E. Hyten highlighted the need to reexamine war-fighting concepts after a high-profile wargaming exercise loss in October 2020.[17] One of the changes Hyten noted was a desire to move away from aggregating forces to a new concept dubbed "expanded maneuver." The range of possible alternatives to pursue the expanded maneuver concept is undoubtedly vast, and the associated costs of these options are likely to vary widely. Implementing a cost-effectiveness analysis of these alternatives can inform decision makers during their tradeoff analyses. Thus, the window of opportunity for major changes in wargame concepts (such as expanded maneuver) is also an opportunity to consider more seriously other decision variables such as cost in wargame analysis.

Conclusion

To date, this research represents the first inclusion of cost in wargaming analysis. Despite being an initial examination into wargaming costs, the research has several key implications. First, the cost methods developed can be used to study the aircraft, munitions, unexploded ordnance, and rapid airfield damage recovery costs of each wargame, as well as aircraft use rates. These costs can be used to identify cost drivers. For example, analysis may determine the distance between the US military's center of gravity and the enemy's center of gravity is a good predictor of cost. These cost drivers can in turn be used to predict costs of future conflicts. This same idea can be used for effectiveness.

Second, the comparison between cost and effectiveness stimulates important tradeoff discussions. The model allows for a larger analysis between wargames.

Comparing the effectiveness of decisions in a wargame can now be quantified where cost is considered as one of the decision variables. Certainly, there are potential limitations to this analysis. If it is decided after the wargame that cost savings were available, and the wargame is rerun considering these cost-saving measures, the effectiveness of that wargame may be reduced further than the relationship between cost and effectiveness may suggest. This reduction would most likely be caused by unanticipated secondary effects such as fuel usage causing a change in aircraft availability; thus, careful considerations are needed when selecting the criteria for measuring effectiveness.

Third, current postgame wargame analysis has been tempered by a sensitivity to the assumptions and limitations of the specific wargame scenario. Undoubtedly, these insights have been highly valued as demonstrated by a single wargame platform spending millions annually for wargame analysis support, but the extant postgame analysis has been limited by the variables analyzed. Bringing the ability to discuss costs in concert with the traditional analysis opens the door for more strategic, long-term applications. The incorporation of cost in wargames can influence Air Force doctrine and can potentially inform strategic decisions in the program objective memorandum *prior* to wartime engagement. These are the types of paradigm-changing insights that have yet to be fully realized through wargaming.

The US military can no longer afford to be reactive in its cost analysis, providing Congress and the American taxpayer with postconflict cost reports. The Department of Defense should instead be proactive in its cost planning. By leveraging cost in wargaming in the Joint planning process, the Department can provide Congress and the American taxpayer a range of potential costs associated with entry into a power competition or conflict or the cost of a tactical or operational engagement.

Additionally, leveraging cost in wargaming allows the military to analyze the cost of conflict as a friendly center of gravity, which, in turn, avoids force culmination due to fiscal constraints. This same logic can also be applied to adversaries' centers of gravity, enabling the military to analyze the impacts of concepts like Joint all-domain operations and expanded maneuvers on enemy fiscal constraints and restraints.

Incorporating cost as a decision variable in wargames opens additional avenues for future research. The main benefits of cost analyses may not be related to the cost or features of a specific weapon system but rather the delivery of a specific capability. Thus, the potential for future research is to develop cost models for capabilities rather than weapon systems. This approach would uncouple wargame costs from the costs of developing a new model for each new aircraft, munition,

or a new method of runway repair. Instead, these models would allow for the cost of stealth air superiority regardless of whether that capability is offered by a current airframe or a future F-XX still to be developed.

Other questions for future research include: How would wargaming analysis change with the inclusion of more costs? How would the model change if the research were conducted at a higher level of classification? These questions open the door to a wide variety of future research to improve the integration of cost into wargaming. The exploratory analysis provided in this article was just the first step of the journey. The door is now open to consider cost as a decision variable in wargames. Through future research and discoveries, the knowledge needed to improve wargaming is possible. ✪

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Notes

1. Garrett Heath and Oleg Svet, "Better Wargaming is Helping the US Military Navigate a Turbulent Era," Defense One, August 19, 2018, https://www.defenseone.com/.
2. Defense Science Board (DSB) Task Force on Survivable Logistics, *Task Force on Survivable Logistics: Executive Summary* (Washington, DC: Department of Defense (DOD) DSB, October 26, 2018), https://dsb.cto.mil/.
3. DSB, *Executive Summary*.
4. James N. Mattis, *Summary of the 2018 National Defense Strategy of the United States of America: Sharpening the American Military's Competitive Edge* (Washington DC: Office of the Secretary of Defense, January 2018), https://dod.defense.gov/.
5. Quoted in Tyler Hess, "Cost Forecasting Models for the Air Force Flying Hour Program," (master's thesis, Air Force Institute of Technology (AFIT), March 2009), 12.
6. F. Michael Slay and Craig C. Sherbrooke, *Predicting Wartime Demand for Aircraft Spares*, AF501MR2 (McLean, VA: Logistics Management Institute (LMI), April 1997); and John M.

Wallace, Scott A. Houser, and David A. Lee, *A Physics-Based Alternative to Cost-Per-Flying-Hour Models of Aircraft Consumption Costs*, AF909T1 (McLean, VA: LMI, August 2000).

7. National Park Service, Valley Forge National Historical Park, Pennsylvania, "General von Steuben," accessed August 5, 2019, https://www.nps.gov/.

8. Matthew Caffrey Jr., "Toward a History-Based Doctrine of Wargaming," *Aerospace Power Journal* 14, no. 3 (Fall 2000), https://www.airuniversity.af.edu/.

9. Caffrey, "Wargaming."

10. David A. Shlapak and Michael Johnson, *Reinforcing Deterrence on NATO's Eastern Flank: Wargaming the Defense of the Baltics* (Santa Monica, CA: RAND Corporation, 2016), https://www.rand.org/; Rick Brennan Jr., *Protecting the Homeland: Insights from Army Wargames* (Santa Monica: RAND Corporation, 2002), https://www.rand.org/; Yuna Huh Wong et al., *Next-Generation Wargaming for the U.S. Marine Corps: Recommended Courses of Action* (Santa Monica, CA: RAND Corporation, 2019), https://www.rand.org/; and Brien Alkire, Sherrill Lingel, and Lawrence M. Hanser, *A Wargame Method for Assessing Risk and Resilience of Military Command-and-Control Organizations* (Santa Monica, CA: RAND Corporation, 2018), https://www.rand.org/.

11. Daniel A. Krievs, "Integrating Agile Combat Support within Title 10 Wargames" (master's thesis, Air Force Institute of Technology [AFIT], 2015), https://scholar.afit.edu/; and Kevin R. Cardenas, "Logistics Simulation for Long Duration Logistics Wargames" (master's thesis, AFIT, 2016), https://scholar.afit.edu/.

12. E. B. Potter, *Nimitz* (Annapolis, MD: Naval Institute Press, 1976), 136.

13. Office of the Secretary of Defense Cost Assessment and Program Evaluation (OSD-CAPE), *Operating and Support Cost-Estimating Guide* (Washington DC: OSD-CAPE, 2014), https://www.cape.osd.mil/.

14. Slay and Sherbrooke, *Aircraft Spares*; and Wallace, Houser, and Lee, *Aircraft Consumption Costs*.

15. Department of the Air Force (DAF), *Introduction to Rapid Airfield Damage Recovery (RADR)*, Air Force Tactics, Techniques, and Procedures 3-32.10 (Washington, DC: DAF, October 15, 2019), https://static.e-publishing.af.mil/.

16. Chairman of the Joint Chiefs of Staff (CJCS), *Joint Planning*, Joint Publication 5-0 (Washington, DC: CJCS, December 1, 2020), https://www.jcs.mil/.

17. Tara Copp, "'It Failed Miserably': After Wargaming Loss, Joint Chiefs are Overhauling How the US Military Will Fight," Defense One, July 26, 2021, https://www.defenseone.com/.

Cost-of-Delay

A Framework for Air Force Software Factories

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The Air Force software development environment is experiencing a paradigm shift. The 2019 Defense Innovation Board concluded that speed and cycle time must become the most important software metrics if the US military is to maintain its advantage over adversaries.[1] This article proposes utilizing a cost-of-delay (CoD) framework to prioritize projects toward optimizing readiness. Cost-of-delay is defined as the economic impact resulting from a delay in product delivery or, said another way, opportunity cost. In principle, CoD assesses the negative impacts resulting from changes to the priority of a project.

The cost-of-delay concept has been successfully employed in the private sector and has been suggested for use in military budget management.[2] But this concept requires tailoring to fit the unique nature of a public sector entity. To test a proof of concept for a new defense-centric cost-of-delay model, an Air Force research team engaged in a CoD process with Kessel Run.

Patterned after commercial-sector practices, Kessel Run eschews traditional software development techniques in favor of emergent, Agile principles.[3] The 2019 Defense Innovation Board supported this change, stating, "DoD must move from waterfall and spiral development methods to more modern software development practices such as Agile, DevOps, and DevSecOps."[4] The goal of this transformation

is the global delivery of war-critical software through rapid feedback loops and a user-centered design.[5] But changing to the Agile development environment has introduced new challenges that could undermine the Air Force's ultimate goal of maximizing a finite budget. Kessel Run currently relies on expert judgment calls rather than repeatable and verifiable quantitative methods to prioritize their various product lines.

The Case for Cost-of-Delay

Software, a ubiquitous component of our military systems, is vital to national defense. A 2010 National Research Council report stated the DOD software code increased by more than an order of magnitude every decade between the 1960s and the 2000s, equating to approximately 25 percent annual growth.[6] A 2017 estimate projected an annual growth rate of 15–25 percent in the demand for developing and maintaining all defense software.[7]

The volume of code combined with the increasing complexity of integration is pressuring management to meet project objectives. Particularly, the schedule has caused concerns in recent years. The 2019 Defense Innovation Board concluded the capacity (or lack thereof) of the Department of Defense to rapidly develop and deploy effective software directly and negatively impacts the Department's ability to adapt and respond to threats.[8]

The delays to the F-35 delivery due to problems with software testing is just one notable example of how speed is key to mission readiness.[9] The Department has thus begun to employ Agile software management as a technique that prioritizes timeliness. But by extension, a prioritization model that includes a component of timeliness may likewise need to be employed.[10] This article proposes cost-of-delay.

The Department's adoption of CoD has been investigated before.[11] In the late 1990s, the Air Force explored CoD as part of the Air Force Cycle Time Reduction initiatives, but it did not gain traction.[12] At the time, the Department of Defense was largely employing a waterfall method of development. Traditional DOD development practices such as waterfall are done in sequential steps with long timelines, which permits time-consuming but possibly more robust prioritization techniques. For its simplicity, CoD lacks appeal in such an environment.

But now that the Department is employing Agile software development in some environments, it needs decision-making tools that can keep pace. Agile is characterized by reduced cycle times and continuous customer feedback. In this fast-paced environment, decision makers need a quick, defensible method with which to make trade-offs. Of note, discussions as to the merits of various software development approaches are outside the scope of this article.[13] Rather, the De-

partment of Defense's shift (right or wrong) to Agile presents a new opportunity to evaluate how prioritization occurs.

Requirement prioritization methods in defense programs deserve discussion because the impact of these prioritization decisions reverberates throughout the defense portfolio and affects military readiness. One method commonly employed to organize the sequence and prioritization of work is first-in, first-out (FiFo).[14] This method is frequently used in inventory management systems to ensure older products are used before new ones. But in a software development environment, FiFo may lead to inferior value or readiness.

Certain software requirements are more critical than others, and some requirements can quickly become obsolete due to the dynamic nature of software. As a result, recent software organizations have looked beyond FiFo to techniques that can speedily assess value. Two such applied approaches are the Kano and MoSCoW models.

The Kano model uses teams to categorize software requirements into five classifications based upon the customer's needs.[15] The MoSCoW method takes a similar approach but with different classification groupings.[16] Both approaches are similar in that they qualitatively group requirements by the degree of customer need. Both models rely on the assessment of subject matter experts to create the groupings, but relying on these qualitative judgments is their greatest weakness.

Why is this an issue? Research in 2013 by Joshua J. Arnold and Özlem Yüce revealed a problem identified as the highest-paid person's effect (HiPPO).[17] The HiPPO, typically the most senior individual in the room, remained adamant about the importance of certain requirements during the prioritization and planning stages. The study found eight other features appeared to be more valuable than the HiPPO's original choice. Clearly, overreliance on subject-matter-expert qualitative assessments can be problematic. Therefore, this article proposes CoD—a quantitative-based approach—as an alternative prioritization mechanism.

Anatomy of Cost-of-Delay

The CoD concept originated from Donald G. Reinertsen's seminal work quantifying the value of development speed.[18] Reinertsen found a six-month delay can be worth 33 percent of life-cycle profits.[19] These fundamental insights—time is valuable and quantitative economic analysis can improve decision-maker intuition—sparked a commercial-sector emphasis on lean product development and CoD implementation.[20] Over time, experimentation with CoD analyses in comparison to other methods revealed important insights. More specifically, the comparisons revealed the value of time is *not* intuitive, and decision makers often ar-

rive at divergent conclusions in the absence of a formal CoD model.[21] Thus the need for CoD modeling was established.

This article uses the 2013 research by Arnold and Yüce, which further developed this CoD construct, as the framework for the CoD model.[22] The efficacy of their construct was recently demonstrated through application by the international container shipping company, Maersk SeaLand.[23] This construct consists of three components: *benefit type*, *urgency profile*, and *development duration*.

The first component includes four different benefit types—*increase revenue*, *protect revenue*, *reduce costs*, and *avoid costs*.[24] Benefits are categorized by features that increase sales, help retain the business of existing customers, improve efficiency, or prevent foreseeable future costs. Because this study focuses on software, our explanation of these four benefit types uses the software nomenclature "features" to describe a distinguishing characteristic of the software item. The Institute of Electrical and Electronics Engineers defines the term in IEEE 829.

Urgency profiles, the second component of the model, are used to understand the life cycle of benefits and effects of being late.[25] Urgency profiles are categorized as *short life-cycle peak affected by delay*, *long life-cycle peak affected by delay*, *long life-cycle peak unaffected by delay*, and *impact of external deadline*. Each urgency profile is depicted in figure 1.

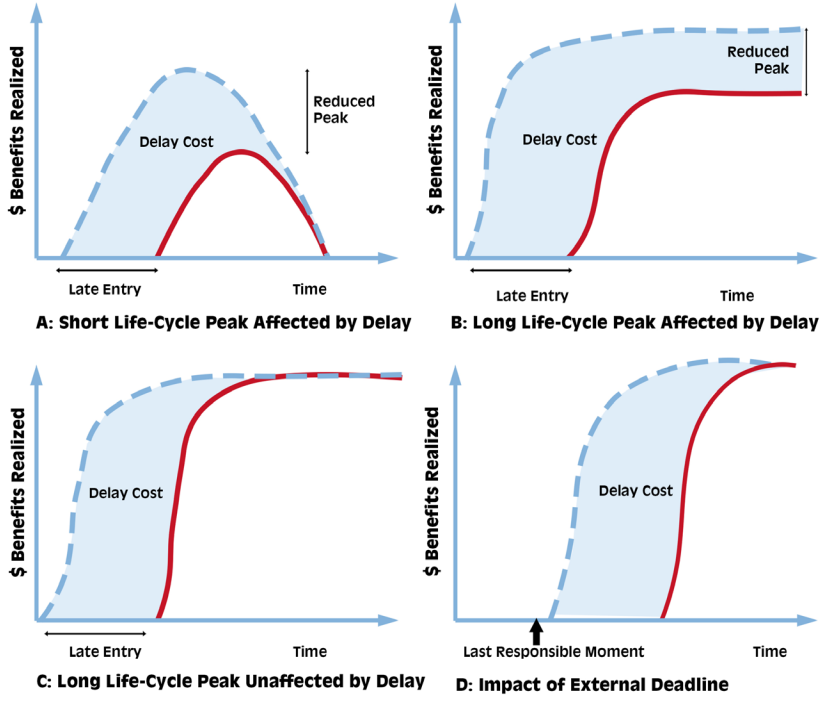

Figure 1. Urgency profiles

The third CoD component, *development duration*, is the amount of time necessary to complete a requirement. Combining a requirement's benefit type and urgency profile and dividing by the development duration produces a CoD score that can be compared to other requirements.[26]

This calculation is a quantitative optimization framework to help prioritize requirements, tasks, or new work solely from a cost perspective. In economic terms, it is the opportunity cost between having some value now versus later. The opportunity cost is expressed as the dollar value that could be generated or saved per unit of time (days, weeks, months, etc.). To prioritize, the requirements with the highest opportunity costs per unit of time should be completed first.

A Public Sector Cost-of-Delay Model

The components of the CoD model outlined above must be modified for a public sector entity. An evaluation of the economic structure of government organizations and discussions with Kessel Run personnel concluded not all benefit types or urgency profiles were relevant. The benefit type *reduce cost* was included in the modified public-sector CoD model, and benefit types *increase revenue* and *protect revenue* were excluded. Urgency profiles *long life-cycle peak unaffected by delay* and *impact of external deadlines* were included in the modified public sector CoD model, and urgency profiles *long life-cycle peak affected by delay* and *short life-cycle peak affected by delay* were excluded.

The *increase revenue* and *protect revenue* benefit types are excluded from the model as a result of their association with profit generation. Due to the public goods nature of defense, Kessel Run and other public sector entities are not inherently revenue-seeking institutions, but *reduce cost* and *avoid cost* are relevant for a government setting.[27] *Reduce cost* covers changes that improve the overall efficiency of operations. *Avoid cost* consists of costs not currently incurred but may be in the future. Kessel Run's personnel identified both as the types of requirements or features their organization typically completes.

One urgency profile, *short life-cycle peak affected by delay*, is excluded from the public sector model. This urgency profile is identified when benefits are relatively short in duration and dictated quickly by market demand. For example, in the fashion industry, if a designer is late, the value of their commodity can be significantly reduced.[28] The assumption is DOD demand for certain capabilities typically will not fluctuate enough over short periods to warrant the consideration of this urgency profile.

The *long life-cycle peak affected by delay* profile is included in the public sector model. This urgency profile identifies features characterized by a clear first-mover advantage that penalizes latecomers.[29] It highlights benefits and costs associated

with falling behind rival competition—in the case of the Department of Defense, competition from other countries. The current US-China competition in space, in which the first mover would have the upper hand in a potential conflict, is characterized by this urgency profile.

The *long life-cycle peak unaffected by delay* profile applies to the Department as well, occurring when life-cycle benefits ramp up to a peak and are sustained over an extended period.[30] An example of this profile is process automation. The opportunity cost (measured in money per unit of time) is the same regardless of whether the acquisition is a first-mover or latecomer. All that matters is how many units of time it is available sooner, not which units of time. As a result, this urgency profile is the most common and easiest to compute.

The *impact of external deadline* urgency profile is also included in the model. In this configuration, a specific deadline is associated with a feature, and the CoD only begins to ramp up as it approaches the "last responsible moment."[31] To compute these profiles effectively, the team considers the lead time required to complete a particular feature and calculates an on-time delivery. Features that fall under this category are tied to a specific delivery date and will have a CoD of zero until the last responsible moment.

In summary, the CoD model can be modified for public sector use. Note, however, that the resulting CoD score should be considered in context with other available information. While the CoD will provide a quantitative, dollarized result for prioritizing requirements, other intangible benefits are not easily captured with a simple dollar estimate, for example, military or trade secrets. For this reason, the DOD cost-of-delay assessments are recommended as a complementary tool to help prioritize requirements but should not be considered a final, optimal solution in isolation.

Cost-of-Delay Model Test Case: Kessel Run

The test case for the CoD framework used data for analysis from two Kessel run application teams. The specific application teams—Chainsaw and Jigsaw—are part of Kessel Run's operational command and control users product line. Each application team provided software features from their product backlog. For disclosure reasons, the exact specifications and descriptions of the features are not revealed. But both teams provided details regarding the work to be done as well as the potential cost savings to be gained from successful implementation.

The Chainsaw and Jigsaw teams used two features each for this analysis. In this simple model, it is assumed features are developed sequentially with no overlap. The four features analyzed identify reductions in manpower hours to determine

their cost-saving capabilities. The calculations considered included the *reduce cost* benefit type and followed the *long life-cycle peak unaffected by delay* urgency profile.

The opportunity cost was measured solely in terms of manpower costs, with Air Force Instruction 65-503, Table A33-1 providing the fiscal year 2020 hourly cost rates for active-duty military members used in the calculations. Table 1 provides the opportunity cost, development duration, and CoD scores for the four features provided by Chainsaw and Jigsaw. The research team prioritized the features with the highest CoD score resulting in the following order: Jigsaw Feature 2 (1140), Chainsaw Feature 1 (161), Jigsaw Feature 1 (152), and Chainsaw Feature 2 (24).

Table 1. Cost-of-delay scores for Kessel Run test case

Application Feature	Opportunity Cost	Development Duration (weeks)	CoD Score
Jigsaw Feature 1	$456/week	3	152
Jigsaw Feature 2	$1140/week	1	1140
Chainsaw Feature 1	$483/week	3	161
Chainsaw Feature 2	$24/week	1	24

The CoD scores in table 1 determine the order in which the four features should be undertaken. The CoD dollar value for the full set of features based on that prioritization required a second calculation. More specifically, the CoD incurred while developing Jigsaw Feature 2 was calculated as shown below (fig. 2).

$$= (\text{CoD JF 1} + \text{CoD JF 2} + \text{CoD JF 1} + \text{CoD JF 2}) * \text{Duration JF 2}$$

$$\$2103 = \left(\frac{\$456}{\text{week}} + \frac{\$1140}{\text{week}} + \frac{\$483}{\text{week}} + \frac{\$24}{\text{week}} \right) * 1 \text{ week}$$

Figure 2. CoD score = opportunity cost/duration

Note: Opportunity cost is a function of *benefit type* and *urgency profile*

Following this formula, the cost-of-delay incurred while working on Jigsaw Feature 2 was $2,103. When working on Chainsaw Feature 1, since Jigsaw Feature 2 was already accomplished, the calculation only considered the CoD of Jigsaw Feature 1, and Chainsaw Feature 1 and 2. The Chainsaw Feature 1 CoD calculated as $2,889 ($456/week + $483/week + $24/week *3 weeks). Next, on the third prioritized feature, Jigsaw Feature 1, the CoD calculated as $1,440 ($456/week + $24/week *3 weeks). Last, when working on Chainsaw Feature 2, the CoD was $24. Adding these four CoD values together provided a total CoD of $6,456, the lowest solution to this particular data set. Alternatively, had the team prioritized the features using a FiFo calculation, the total CoD would have been $9,479.

The Kessel Run test case demonstrates several important points. First, the analysis reveals how some features are more significant than others from an opportunity-cost standpoint. Jigsaw Feature 2 and Chainsaw Feature 2 represent the greatest and smallest opportunity costs, respectively. Even with a small data sample, these results highlight the disparity that can be found when considering the importance of a product backlog.

Typically, a development team would focus on the features most important to the user. The assumption is the most important features will have the greatest operational opportunity costs. Therefore, CoD analysis provides a more quantitative and potentially more defensible way to illustrate which features are the most impactful to the user.

Second, these CoD assessments show how nonoptimal sequencing can add up to significant cost increases. For example, starting with the nonoptimal sequence of Chainsaw Feature 2—perhaps under the guiding principle "completing quick features"—would have yielded a large opportunity cost. Once again, the data set only represents a small sample of the potential cost saving. But with just this initial assessment, an increase in manpower efficiency from one feature can save the government thousands of dollars per week. A deeper discussion on the other cost-saving capabilities and the CoD quantification of the multitude of other features in the backlog could reveal even more efficiencies that could be achieved through the successful implementation of certain features.

Discussion

Cost-of-delay provides an organization with a methodology to optimize its portfolio's structure. To be clear, this article does not suggest CoD is a panacea. Rather, CoD is simply a quantitative method to improve decision making. It is important to note the opportunity for human mediation in the process is preserved. Agile development's flexible, iterative nature, coupled with intensive user feedback, ensures this mediation occurs.

While the CoD score establishes an initial means to prioritize features, leadership can adjust scores based on other subjective goals or those factors that directly impact war fighting and thus national defense readiness levels. Those gains must be considered in conjunction with the CoD model. What cost-of-delay adds to the current process is a quick, defensible framework through which decision makers can make better-informed trade-offs.

While this article provided the necessary framework for CoD implementation in the public sector, the demonstration of the CoD concept in a DOD organization is clearly limited. The duration of the prioritized features was short, and the dollar amounts were small. Yet this example should stimulate conversations in

organizations about the applicability of the CoD approach within the parameters of unique project or program characteristics.

The Air Force shift toward the Agile software development environment is the impetus to consider implementing novel CoD methodologies. The emphasis on valuing speed, cycle time, and user feedback lends itself to a CoD approach. The experience of the private sector provides sufficient evidence. The benefits to organizations are demonstrable in three areas: (1) making better decisions; (2) prioritizing in a way that maximizes value; and (3) changing the focus from efficiency and cost (which encourages wrong behavior) to speed and value.[32] By tailoring the private-sector CoD model to the unique nature of a public sector defense organization, this study's Kessel Run test case suggests Air Force implementation is possible.

The positive outcomes experienced by the private sector directly translate to benefits for the war fighter. The war fighter gains from capability being delivered more quickly to the field, in part due to better decisions in the prioritization process. Cost-of-delay is one component that feeds the decision-making process. The magnitude of those benefits within larger projects will undoubtedly vary based upon specific circumstances. The suggestion from the data examined in this article indicates there is potential for large gains, but results must be caveated. Costs associated with gathering inputs to the CoD model, including the time required of the program manager and other subject matter experts to quantify impacts, were relatively low in this proof of concept. Yet those costs may rise and should be accounted for in a larger application of the CoD concept.

And as mentioned previously, CoD is a tool designed to provide value when prioritizing requirements. Implementing CoD will not alleviate all software development costs and schedule problems. Other models, such as cost of quality, that are constructed to help with some of these software development problems should be considered in conjunction with the CoD model.[33]

The benefit from CoD is simple but important. It provides a cost-efficient approach to prioritizing features, once the program manager has determined the desired quality level of the software development. Thus, the utility of CoD to an organization should be evaluated within the context for which it was designed. Cost-of-delay provides one key piece of information to the decision maker but must be used in conjunction with other data when analyzing the holistic software development process.

The Kessel Run test case demonstrated in this article was important as a proof of concept. But it is only the beginning. Air Force software factories applying Agile techniques are emerging at a rapid rate. Larger-scale testing of the CoD concept in these USAF Agile development environments is warranted. Through

iterative feedback, organizations can modify and improve upon the CoD framework provided. If these endeavors are successful, future research should examine expanding the CoD concept for potential adoption by a wide range of other Air Force programs. ✪

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Notes

1. J. Michael McQuade et al., *Software is Never Done: Refactoring the Acquisition Code for Competitive Advantage* (Washington, DC: Defense Innovation Board, March 21, 2019), viii, https://media.defense.gov/.
2. Donald G. Reinertsen et al., "An Overview of Cost-of-Delay Analysis: Calculating Project Decision Rules," *Journal of Cost Analysis & Management* 4, no. 1 (2002), https://www.tandfonline.com/.
3. McQuade et al., *Software is Never Done*, 10.
4. McQuade et al., *Software is Never Done,* 10.
5. "So You Want to Work for Kessel Run?," Kessel Run (website), accessed September 29, 2021, https://kesselrun.af.mil/.
6. National Research Council, *Critical Code: Software Producibility for Defense* (Washington, DC: National Academies Press, 2010), 19, https://www.nap.edu/.
7. David M. Tate, *Software Productivity Trends and Issues Conference Paper*, NS D-8365 (Alexandria, VA: Institute for Defense Analyses, March 2017), 1–2, https://apps.dtic.mil/.
8. McQuade et al., *Software is Never Done*, 1.
9. Government Accountability Office (GAO), *F-35 Joint Strike Fighter: Problems Completing Software Testing May Hinder Delivery of Expected Warfighting Capabilities* (Washington, DC: GAO, March 24, 2014), https://www.gao.gov/.

10. David Vergun, "Hicks Provides Overview of DOD Priorities," Department of Defense News, June 8, 2021, https://www.defense.gov/.
11. Reinertsen et al., "Cost-of-Delay."
12. Todd S. Butler, "Cost-of-Delay Analysis (CODA): Use and Implementation of This Decision Support Tool" (master's thesis, Air Force Institute of Technology, 2005), 16.
13. Barry Boehm, "Get Ready for Agile Methods, with Care," *Computer* 35, no. 1 (January 2002), https://citeseerx.ist.psu.edu/; S. Balaji and M. Sundararajan Murugaiyan, "Waterfall vs. V-Model vs. Agile: A Comparative Study on SDLC," International Journal of Information Technology and Business Management 2, no. 1 (June 2012), https://moam.info/; and Tsun Chow and Dac-Buu Cao, "A Survey Study of Critical Success Factors in Agile Software Projects," *Journal of Systems and Software* 81, no. 6 (June 2008), https://www.sciencedirect.com/.
14. H. M. Manohar and S. Aappaiah, "Stabilization of FIFO System and Inventory Management," *International Research Journal of Engineering and Technology* 4, no. 6 (June 2017): 5631–34, https://www.irjet.net/.
15. "What is the Kano Model?, Kano Model (website), accessed September 30, 2021, https://kanomodel.com/; and Emmanual O. C. Mkpojiogu and Nor Laily Hashim, "Understanding the Relationship between Kano Model's Customer Satisfaction Scores and Self-Stated Requirements Importance," SpringerPlus 5, no. 197 (2016), https://doi.org/.
16. Dai Clegg and Richard Barker, *Case Method Fast-Track: A RAD Approach* (Boston: Addison-Wesley Longman, 1994).
17. Joshua J. Arnold and Özlem Yüce, "Black Swan Farming Using Cost of Delay: Discover, Nurture, and Speed up Delivery of Value," in *2013 Agile Conference* (New York: Institute of Electrical and Electronic Engineers, 2013): 101–16, https://doi.org/.
18. Donald G. Reinertsen, "Whodunit? The Search for the New-Product Killers," *Electronic Business* 9 (July 1983): 62–65.
19. Reinertsen, "Whodunit?," 62.
20. Donald G. Reinertsen, *Managing the Design Factory: A Product Developer's Toolkit* (New York: Simon & Schuster, 1997).
21. Reinertsen et al., "Cost-of-Delay," 9–10.
22. Arnold and Yüce, "Black Swan Farming."
23. Arnold and Yüce, "Black Swan Farming."
24. Arnold and Yüce, "Black Swan Farming," 105–6.
25. Arnold and Yüce, "Black Swan Farming," 108.
26. Joshua J. Arnold, "Cost of Delay Divided by Duration," Black Swan Farming, January 5, 2014, https://blackswanfarming.com/.
27. Paul A. Samuelson, "The Pure Theory of Public Expenditure," *Review of Economics and Statistics* 36, no. 4 (November 1954): 387–89, https://doi.org/.
28. Arnold and Yüce, "Black Swan Farming," 108.
29. Arnold and Yüce, "Black Swan Farming," 108.
30. Arnold and Yüce, "Black Swan Farming," 108.
31. Arnold and Yüce, "Black Swan Farming," 108.
32. Ben Linders, "Using Cost of Delay to Quantify Value and Urgency," InfoQ, February 6, 2015, https://www.infoq.com/.
33. Joseph M. Juran, Leonard A. Seder, and Frank M. Gryna, *Quality Control Handbook*, 2nd ed. (New York: McGraw-Hill, 1962).

Theorist, Prophet, or Ideologue?

Review of "False Gospel for Airpower Strategy? A Fresh Look at Giulio Douhet's *Command of the Air*"

Daniel Connelly
Tony Hughes

The influence of World War I Italian general Giulio Douhet on the US Air Force has fascinated many for years. Why Douhet? Where and when did this influence begin to exert its force? What are its effects, and why are they persistent? Tami Biddle opines that Douhet earned his niche as an airpower fixture only from his composition of "futurist drama" and not from any "analytical rigor of his ideas."[1]

John Andreas Olsen's *History of Air Warfare* asserts that Douhet's ideas lack universal validity, yet, perplexingly, hails him as a "great prophet."[2] What is the reason for this inconsistent perspective? Michael Pixley's important 2005 article, "False Gospel for Airpower Strategy? A Fresh Look at Giulio Douhet's *Command of the Air*" is one of the few works that calls for a deeper examination of the benefits of Douhet's influence.[3] Pixley maintained that Douhet is far more often cited than understood. In other words, most authors *assume* the value of his influence and extrapolate from its mention and his ideas but rarely evaluate the underlying basis or desirability of his influence.

If Pixley is right, an implication surfaces: while Douhet may fill a psychological need, he may be inadequate as an exemplar of clear thinking on airpower, and his legacy requires reconsideration. Pixley's fundamental claim is that Douhet's status as an airpower theorist or farsighted prophet of modern airpower's utility

is undeserved due to the locality versus universality of his ideas and his lack of philosophical rigor.

This commentary seeks to extend Pixley's thesis, first arguing if he is neither theorist nor prophet, he is primarily an *ideologue* whose skewed perception of the relationship between the human person and the larger community derives from a fascist orientation. Second, his true influence derives from the mythos that still accumulates around his name and imparts a permissiveness to a particular set of ideas on airpower, including the conception of airpower as a talisman to solve political problems. Third, this conception may interact strongly with certain features in the landscape of US thinking on power and the military, thus requiring vigilance on the part of those in such circles and the assertion of an intellectual turn to a better—and contrasting—airpower legacy.

In 2021, the US Air Force is, in the eyes of many, at a crossroads of sorts regarding the role and value of airpower. In some ways, this moment may resemble the crossroads the service encountered in 1991. The question has become important enough, in fact, that the Air Command and Staff College dean recently asked students and faculty to reconsider the past 30 years of the use of airpower—what have we learned, and what have we forgotten?

Somehow in the circles of strategic thinking and discourse on the uses of the military, Douhet has retained a significant stature in airpower literature. He is read at professional military education institutions, his books are discussed, and his prescriptions are considered. What roads regarding the use of airpower would Douhet lead us down today, and are these the most helpful journeys in responding well to the above demanding questions? In sum, Pixley's 2005 call for a reexamination of Douhet's influence is still relevant, and in light of recent history and the implications of this commentary, perhaps even more urgently needed today.

Pixley began by asking if Douhet's theory of airpower was still relevant at the turn of the twenty-first century. The answer to that question, Pixley maintained, must lie within the context of Douhet's time, place, and circumstance. Of particular importance was the peculiarity of interwar Italy, which led to the first constraint of Douhet's relevance, in Pixley's view.[4] He asserted that Douhet's thoughts were limited by an extreme version of local applicability.

Reality as proposed by Douhet begged the caution of airpower theorists in their efforts to extrapolate a universalism of thought and practice. Pixley repeatedly urged his readers to return to Douhet's acknowledged primacy of thought, which sought an Italian return to glory as shaped by the suffering of the Great War. Douhet yearned for a future that technology and airpower could be used to seize. His zeal for such grand endeavors influenced his formation as a man and as a fascist, which left arguably little room for scholarly objectivity.[5]

Douhet's suffering in World War I and his zeal for a glorious future drove his philosophical worldview. Pixley provided ample evidence that Douhet viewed war in a strictly mechanistic way, devoid of the human element. His thoughts could not be separated from what Pixley labels as technological rationalism.[6] To illustrate Douhet's commitment to rationalism, Pixley positioned the Italian's approach with that of Carl von Clausewitz and Baron de Jomini.

Where Clausewitz viewed war as complex and full of uncertainty, Douhet argued for a puritanical science of simple algebraic certainty. While Jomini also viewed war as a science, Douhet veered toward a greater extremism that denied the immutable human factors of war and historical principles of strategy. Pixley notes that while Clausewitz and Jomini occupied opposite ends of the spectrum, Douhet maintained an inconsistency not tethered to anything certain.[7] Ultimately, he lacked theoretical and philosophical rigor, which riddled his thoughts and actions with contradiction.

Despite the significance of Douhet's flaws and limitations, Pixley lamented the deleterious effects of his thought on the development of American airpower. Pixley noted particular elements of Douhet's thoughts had historically infected the US Air Force, resulting in an unrestrained pursuit of technology, an aversion (at best) and rejection (at worst) of history, and a stagnant view of the various other elements of warfare such as defensive maneuvers and combined-arms operations.[8]

For Pixley, such disordered thought continued to influence Air Force strategy, doctrine, and policy, where Douhet's theories were used to bolster an erroneous belief in a new age of technological primacy as indicated by the advent of ballistic missiles and nuclear warfare. Pixley concluded Douhet must be placed in his proper context, namely, his time, place, and circumstance. To do otherwise was to betray Douhet himself and cast a shadow on the ordered development of twenty-first-century airpower strategy. Douhet was neither a sound theorist nor a prophet.

So Pixley's first major contribution to clarity on Douhet's legacy is his warning that—regarding the uses of all thinkers—we must first strive to ascertain the applicability of their ideas, and in this case to understand Douhet's ideas as local, time-bound, and potentially dangerous. His ideas are dangerous most of all because Douhet's true focus was a fascistic solution to a uniquely Italian problem.

Douhet's own words, along with the views of serious scholars such as Biddle, Michael Sherry, and Robert Pape, remove him from the ranks of first-rate airpower theorists whose ideas extend at least to some universal applicability. In contrast to the clairvoyance and versatility of the ideas of a Clausewitz or Jomini, the "grandiose" Douhet, devoutly concerned with the destiny of Italy and caught up in the Italian brand of fascism, was much more likely proposing a fascistic

solution to an Italian problem—a fascistic demeanor recognizable in its emphasis on *total society* and *total war*.

Douhet's solution was fascistic because a careful reading of his writing shows that, ahead of his time in this respect given Adolph Hitler's Germany and Lenin and Joseph Stalin's Soviet Union, Douhet appears to have conceived of Italian culture as becoming, and needing to become, what may be called a total society, with every resource and every person reduced to a benefit or harm to the State and treated thus—benefits permitted to exist and receive sustenance and harms eliminated.

This brutal and bland unity was Douhet's prescription for achieving a future dominant Italy, described by Pixley as a vision in Douhet's mind of Italy as a "burgeoning world power with 'an imperial destiny' employing aviation as a tool 'with which to carve out her future.'"[9] In this vision of a dominant Italy and as a total society, Douhet merely shared the views of his intellectual companion, Benito Mussolini, famous for many statements about politics including these two: "All within the State, nothing outside the State, nothing against the State" and "We have buried the putrid corpse of liberty."[10]

The total society, utterly antithetical to anything the United States purports to stand for, was the particular object of Aldous Huxley's scorn in his 1931 *Brave New World*: "The completely organized society. . . . The abolition of free will by methodical conditioning, the servitude made acceptable."[11]

Closely linked to Douhet's total society view is his adoption of a total war mindset, in which one sees war not as defined by its political end but as serving itself and further sees that once decision makers select recourse to war, the only legitimate restraint on war making is what fails to serve war's destructive force. The possible effects of such a total war mindset on a culture—any culture—constitute a warning that should have our full attention.

No State is a priori immune from such a mindset, as we see in Andrew Bacevich's review of Tommy Frank's *American Soldier*, where Bacevich claims a generation of past US military leaders had sought to "purge war of politics, reconstituting the conception of war as the exclusive province of military professionals."[12] More than merely acknowledging war's destructive dimension, this dangerous mindset cultivates a permissive quality in which the maelstrom of war must be given its way and the tabulation of costs delayed.

Clearly, one of these costs is the loss of the conception of war as merely one among other tools of the State, as a decidedly human endeavor and as indelibly tied to higher dimensions of human living, such as political objectives, the public's culture and common good, and the demands of justice given the human race's common nature. This bounded conception of war is precisely the point of Clause-

witz's timeless caveat that war has its own grammar but not its own logic! In place of this reasoned conception, once it corrodes, a total war mindset can arise that proposes war as rightly inhuman, qualifies attempts to channel or bound war making as weakness, and deems the preservation of any societal element from the war machine as traitorous.

The above characterization, with its emphasis on a total society and total war mindset, helps us arrive at the danger of Douhet's ideas, caught up as they are in the curious affinity we see between certain fascist leaders and the potentiality of airpower—the thesis of works such as Von Hardesty's essay "Despots Aloft" and Scott Palmer's *Dictatorship of the Air*, on Soviet views of airpower.

The endgame of this manner of thinking is the threat to humanity posed by the total state. In his examination of Mussolini, Hitler, and Stalin on the subject of airpower, Hardesty suggests all three men harbored a fascination with airpower as a kind of talisman, a symbol of power and progress, and more specifically as a harbinger of the total state—a third key concept critical to a more careful reading of Douhet. Walter MacDougall's *The Heavens and the Earth: A Political History of the Space Age* describes with verve the contours of the total state through the use of the term *technocracy*—"the management of society by technical experts" to the exclusion of all nontechnical and especially higher ends.[13]

Palmer's thesis reveals the close connection between the forces of total society, total war, the total state, and airpower when he argues the Bolshevik demand for total uniformity required all state elements to find and destroy all rivals to its ruling ideology. Party ideologues saw airpower with its lethal and seemingly magical properties as a useful reinforcing tool. Under such a view of the State as total, and never as representative or guardian of the freedoms of human persons, all impediments to the state's furtherance qua state—qua apparatus are to be ground into dust, especially human "impediments."[14]

Thus, the total state serves itself at the expense of its human cogs and serves as the principal mechanism by which to achieve the total society. Total war as a mindset is a natural consequence of the thinking behind the first two concepts, and that is why thinking along the lines of any one of the three concepts tends to the admission of all three as legitimate sources of theory and practice. It is the degree to which Douhet accepted on faith and, guided more by passion than reason, preached these ideas about the State and airpower that should concern us.

Pixley made abundantly clear Douhet's problem set was uniquely Italian both in terms of geography and 1920s Italian political-military development. His further charge—that Douhet was a polemicist far more than an able theorist—is also relevant to this claim of the locality of his ideas. This is so, despite the opening words of the foreword to the Air Force History and Museum Program's 1998

edition of Douhet's *The Command of the Air*: "In the pantheon of air power spokesmen, Giulio Douhet holds center stage."[15]

One of Pixley's constant themes was his characterization of Douhet as a polemicist, as in a controversial arguer, and not a theorist. Pixley used this charge to explain how Douhet could so blithely and perhaps irresponsibly appear to extrapolate from Italy's context to a universal one—he was striving for effect and drama not accuracy. Douhet's frame of reference for envisioning the uses and effects of airpower was "Italy's protective Alpine barrier and short flying distances from potential enemies."[16]

Regarding Italian political-military development, Douhet was responding to "a distinct national conversation" and even more precisely addressing questions of military reform dominant in Italian strategic circles of the time.[17] Even Douhet himself often explicitly bound his ideas within Italian circumstances.[18] To summarize this point, as seen in Pixley's narrative, one cannot justifiably excise Douhet's words from the years-long forum he shared with his fellow Italian debaters on military reform, simply extrapolating universal applications from these words devoid of the intellectual context that produced them.

As to Douhet the polemicist, Pixley saw the source of this characterization in Douhet's penchant for dreaming. Even more, as a fascist, Douhet strongly embraced Mussolini's view of Italy as a modern push toward a symbolic ancient Rome.[19] Given Italy's fate since Douhet's time, astute observers have even more reason for refraining from making too much of the utility of Douhet's ideas. His desire for achieving a certain narrative effect may render his corpus even more local and historical and even less relevant to the world powers of today.

This same impediment that led Douhet toward passion and away from reason curtailed his record as airpower prophet. In fact, Pixley explicitly assessed Douhet a failure as a prophet, although if Douhet never truly intended any of us to universalize his ideas, we may decide not to judge him quite so harshly—perhaps he was just being polemical.

Able scholars such as Biddle and Pape have decimated Douhet's assumptions about the trail of airpower's destruction and its independent effects on popular will and the anticipated governmental collapse, and the historical record is clear. What is astonishing, regarding Douhet's record of prophecy, is the revolving door of scholars who claim "time works with Douhet," and that given the development of nuclear weapons and missile technology in recent decades, "Douhet has come into his own."[20]

The mixed record of scholarship on Douhet reveals its own story, especially given that it appears Douhet was neither a credible theorist nor an accurate airpower prophet. The question remains: if he was neither, what, in fact, was he? Not

only were his ideas too local to be useful, whether he consistently caveated this or not, but he suffered from a spate of internal contradictions within his thinking, another drawback Pixley makes apparent.

In contrast to Clausewitz or Jomini, Douhet insisted reality has no "ground," no givens, and despite this insistence on a kind of early postmodern perspective, in which there is no reality but what is socially constructed moment by moment, he defends a rationalism far more stringent than Jomini's. He repeatedly insisted his ideas were somehow "algebraicly" proven and his logic was undeniable, when in the same breath he invalidated the very basis for consistent laws in his rejection of the lessons of history and embrace of oddities such as his overreliance on technology and denial of friction in war.[21]

Perhaps, if he is neither a credible theorist with universal reach nor an able prophet, we may best understand him as primarily an ideologue, that special personality whose first love is the savor of their own ideas, and who fills a psychological need for self and others absent academic rigor, and with potentially dangerous ramifications.

Conclusion

Douhet's true influence may derive from the mythos that still accumulates around his name and imparts a permissiveness to a particular set of ideas on airpower, including the conception of airpower as a talisman to solve political problems. Douhet may still be a fixture in airpower thought because he is wanted, not because he is needed, nor because he helps clarify airpower theory.

Douhet's dream was the application of massive airpower against an enemy's civilian base to speed up its governmental collapse and capitulation. This vision is alluring to some, but what is its true nature and service to higher aims? It may be true that he had a radical faith in technology. It may also be true that he wished to see certain things come about that, in fact, never occurred. This devotion marks him and reveals him as a believer, an ideologue, and possibly an idealist, not as a desirable mentor to guide the development of future US airpower.

To extend Pixley's treatment of Douhet, one of the Italian's biggest accomplishments may be that he proposed a path by which one can escape the bonds of traditional morality when they no longer serve the war cause or national ambitions. A second may be that he wanted to take the age-old ideal of protecting the innocent from the harms of war and throw it into the dustbin of history along with history itself, which he saw as "a chain . . . to which life is tied and carried backwards."[22]

Thus, to follow Douhet's ideas to their logical ends, despite his sense that massive airpower projection would "speed up the war and thereby save life and property," we find his legacy one of moral corrosion, loss of purpose, and a nihilistic

creed that elevates will above any notion of the Good. MacDougall sees this kind of faith that he calls "technocratic" in the USSR's strategic culture from 1917 through the 1980s and—disturbingly—he finds the same aroma making inroads into US strategic culture following the fateful address of outgoing President Eisenhower known as the "Military-Industrial Complex Speech" of 1961. MacDougall's scholarship here is best summed up in the phrase *worship of means*, and if Douhet was susceptible to this, as was the Bolshevik apparatus, is this not something against which we should maintain a constant vigilance?[23]

At least, we should understand its costs, and if a fondness for Douhet or his ideas is present in certain circles, it may be because this same conception, a troubling worship of means, may interact strongly with certain features in the landscape of US thinking on power and the military. Why not consider an intellectual turn to a better—and contrasting—airpower legacy, that of Benjamin Foulois flying over terrain in New Mexico who, quoted by Corum and Johnson, modeled the "Airman's point of view"? "It is this third-dimensional point of view of ground events that sets the Airman apart."[24] ✪

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Notes

1. Tami Biddle, "Rhetoric and Reality in Air Warfare: The Evolution of British and American Ideas about Strategic Bombing, 1914–1945," (Princeton, NJ: Princeton University Press, 2009), 106.
2. John A. Olsen, *A History of Air Warfare* (Sterling, VA: Potomac Books, 2010), 354.
3. Michael D. Pixley, "False Gospel for Airpower Strategy? A Fresh Look at Giulio Douhet's *The Command of the Air*," *ASPJ Chronicles Journal Online* 14 (2005), https://www.airuniversity.af.edu/.
4. Pixley, "False Gospel," 1.
5. Pixley, "False Gospel," 6.
6. Pixley, "False Gospel," 2.
7. Pixley, "False Gospel," 3.
8. Pixley, "False Gospel," 4.
9. Pixley, "False Gospel," 7.
10. Richard J. B. Bosworth, *Mussolini*, new ed. (London: Bloomsbury, 2010), 159.
11. Josef Pieper, *An Anthology* (San Francisco: Ignatius Press, 1989), 227.

12. Andrew Bacevich, "A Modern Major General," *New Left Review* 29 (September–October 2004), https://newleftreview.org/.

13. Walter MacDougall, *The Heavens and the Earth: A Political History of the Space Age* (Baltimore: Johns Hopkins University Press, 1997).

14. Scott W. Palmer, *Dictatorship of the Air: Aviation Culture and the Fate of Modern Russia* (Cambridge, UK: Cambridge University Press, 2007).

15. Giulio Douhet, *The Command of the Air* (Washington, DC: Air Force History and Museums Program, 1998), Foreword, https://media.defense.gov/.

16. Edward Warner, "Douhet, Mitchell, Seversky: Theories of Air Warfare," in *Makers of Modern Strategy: Military Thought from Machiavelli to Hitler*, ed. Edward Meade Earle, Gordon A. Craig, and Felix Gilbert (Princeton, NJ: Princeton University Press, 1943), 499.

17. Pixley, "False Gospel," 6.

18. Pixley, "False Gospel," 1.

19. Phillip Meilinger, "Giulio Douhet and the Origins of Airpower Theory," in *The Paths of Heaven: The Evolution of Airpower Theory* (Maxwell AFB, AL: Air University Press, 1997), 8, https://www.airuniversity.af.edu/.

20. Bernard Brodie, *Strategy in the Missile Age* (Santa Monica, CA: RAND Corporation, 1959), 402.

21. Barry Watts, *The Foundations of U.S. Air Doctrine: The Problem of Friction in War* (Maxwell AFB, AL: Air University Press, 1984), 53, https://www.airuniversity.af.edu/.

22. Azar Gat, *Fascist and Liberal Visions of War* (Oxford: Oxford University Press, 1998), 58.

23. MacDougall, *Space Age*.

24. James S. Corum and Wray R. Johnson, *Airpower in Small Wars: Fighting Insurgents and Terrorists* (Wichita: University Press of Kansas, 2003), 17.

Opportunity Realized

Review of "Ten Propositions Regarding Space Power: The Dawn of a Space Force"

Galen Ojala

"A space service? Someday . . . but not in my career." So thought this writer as a young lieutenant some 20-plus years ago. Yet only a few years later, Lieutenant Colonel Mark E. Harter, USAF, weaved together an Air War College thesis from the thoughts of almost 100 senior space professionals and 50 various writings to formulate "Ten Propositions Regarding Space Power: The Dawn of a Space Force."

Harter, now retired, explained in a recent conversation that his thesis-turned-article was the career space professional's answer to Phillip Meilinger's 1995 "10 Propositions Regarding Air Power."[1] There are fleeting similarities, as tenets of position, and command and control are timeless. But the reader quickly becomes aware that the space domain has unique characteristics requiring a different way of thinking in pursuit of space superiority. Not just a collection of others' thoughts, Harter's "Ten Propositions" is honed by his own experiences integrating space within air operations centers, across space operations, and into fielded systems.

In hindsight, the general accuracy of the propositions is telling considering the article precedes the 2007 and 2013 Chinese antisatellite tests that launched scores of alarmist writings. It also precedes the rapid commercialization and doubling of space-economy participating nations. Within a context of what would later be called a congested, contested, and competitive environment, Harter identified five characteristics and five challenges that identify spacepower as unique from air-

power. From this uniqueness, he made a case for a dedicated professional service to master the domain's potential.

Today, two years into US Space Command's (USSPACECOM) reactivation and the initiation of the new US Space Force (USSF), Harter's article bears reflection. Did theory match reality? Did our nation miss something? As a nation, are we making the required progress? In short, yes, to all three questions. The subsequent reality shaped up as predicted, though faster than expected. Some future realities were missed but not many. Harter did not specifically endorse reactivating USSPACECOM, but he saw the need for dedicated Joint space operational command and control. Additionally, few foresaw the rapid pace of international partner integration and commercial human expansion in space. Meaningful progress is being made, despite a growing to-do list. US space acquisitions are slowly consolidating, but a whole-of-government unity of effort remains unfulfilled. Still, a retrospective look at each proposition is the tale of an opportunity realized.

The Ultimate High Ground

Drawing a loose correlation to the long-held military axiom that holding the high-ground provides advantages, Harter focused on how certain physical geocentric operational locations within space provide information-in-war advantages. This remains true today. Though space offensive and defensive "fires" for combat in, from, and to space are a growing operational discipline, most space-related operations still create and transport information within 22,236 miles of Earth. Despite most activity occurring within Earth's geocentric regime, the area of responsibility, the high ground, grows as nations express a new manifest destiny within the cislunar regime and greater solar system.

A Distinct Medium

Space professionals have experienced collective frustration over the fact that innovative space doctrine was beholden to the airpower halls of Air Combat Command, Global Strike Command, and others.[2] Preceding the reestablishment of USSPACECOM and establishment of USSF, external flag officer feedback invariably kept doctrine focused on how space supports the terrestrial-bound operational theaters.

As Harter points out, the ruling laws of physics differ between the space professional and aviator. Fifteen years later, we added the "three-body (Earth-Sun-Moon) problem" to our professional physics toolbox as China established itself on the moon, and the United States plans its return. Within this context, Douhet gives way in relevance to Mahan and Corbett in the realm of strategic space do-

main thought.[3] Now free of the transient nature of air operations and with an eye to cislunar operations, space professionals are expressing operations in terms of Blue and Black Space, terms more akin to naval brown-water near-shore and blue-water afar operations.[4]

Force Multiplier

True then and today, space is a force multiplier for the United States and its Allies and partners. Our strategic competitors purposely target our systems to deny us proven advantages. Ironically, as our competitors target our weaknesses, they themselves are becoming more reliant on space, opening themselves to the same vulnerabilities as they move beyond their borders.

All Levels of War

As an extension to his first proposition, Harter emphasizes how space operations support information warfare across the tactical, operational, and strategic levels of war. This approach to information warfare encompasses what is now described as the network and cognitive dimensions. How the physical dimension expands operational and strategic impact beyond terrestrial bounds is expounded upon in later propositions.

Leveraging Centers of Gravity

Harter details how achieving military space superiority relates to national economic and commercial space sector vigor. In 2006, the global space industry was valued at $209 billion ($284 billion adjusted).[5] Even with a 2020 pandemic-induced government spending decrease, the global space industry saw an overall 6.6 percent gain to almost $357 billion, with the Space Foundation estimating a value of $447 billion by the end of 2021.[6]

Yet many countries are contravening Harter's predicted outsourcing strategies for purchased space services. Even small nations now desire to attain a level of national capability to achieve some sovereignty over space-derived capabilities. Though not overtly favorable for US businesses, this trend has led to unforeseen intergovernmental strategic partnership opportunities with like-minded nations, wherein the United States has gained strategic advantages, improved long-term affordability, and established norms.

In 2006, US military space was predominantly the purview of the United States alone. Today, the *US Space Force Campaign Support Plan* uses the term "allies" 17 times and the phrase "partners or partnerships" in relationship to international partners, 39 times across the short, 20-page document.[7] In August 2021, strategic

vision met reality as military space chiefs from 24 nations participated with General John W. Raymond during the August 2021 Space Chief's Conference in Colorado Springs, Colorado.

Despite this trend, the global space industry has experienced significant commercial growth, which Harter foresaw would blur the lines between hostile (red), friendly (blue), and neutral (gray) actors.[8] Any action in space impacts all nations. Space has no physical borders, and every nation benefits; consequently space policy is of interest to all with little opportunity for geopolitical fence-sitting.

Assured Access

Starting with a holistic view that space superiority is achieved and sustained by a triad of responsive space lift, space command and control, and counterspace operations, Harter proposes that "reliable, responsive, affordable space lift" is foundational.[9] Spaceport diversification has progressed beyond two choke points. US payloads have launched from the Pacific Spaceport Complex in Alaska, National Aeronautics and Space Administration Wallops Flight Facility in Virginia, and Rocket Labs facilities in New Zealand and Virginia. Operational since 1990, the Pegasus horizontal launch program continues to provide flexible launch with 40 successful launches, and Virgin Orbit joined the ranks of flexible airborne launch in 2021. Unfortunately, despite numerous US government references to "responsiveness," formal responsive space requirements remain elusive. Herein lies a strategic disconnect that leaves current and emerging commercial and international partners guessing as to US government intentions and market demand.

Eyes, Ears, Shields, and Swords

"Controlling space requires eyes, ears, shields, and swords."[10] It seems as if Harter yearns to add, "in a war-fighting domain." Eyes and ears are space situational awareness. Shields involve defensive counterspace, and the swords refer to offensive counterspace. This now seems obvious, but in 2006, classification guides restricted openly discussing space as a war-fighting domain. This restriction continued through China's antisatellite missiles tests into low Earth and geosynchronous orbits. Even by 2015, when General John E. Hyten began the cultural shift from a space operator ethos to that of a war fighter, the United States military could not say space was a war-fighting domain.

Now free of many restrictions, space professionals can discuss space domain war-fighting strategy, doctrine, requirements, and options. This openness to discussing reality outside a classified facility helps address one of Michael Martindale

and David Deptula's 2018 "Conditions for Creating a U.S. Space Force," which equates war fighting to physical kinetic combat.[11]

Centralized Command and Control

Though access to space is foundational, Harter considers effective command and control necessary to orchestrate space superiority. Here he made some of his most profound statements. Though he conflated commanding operations and organizing, training, and equipping, he presaged the need for global and theater space-related operations to be led and fought by space professionals.

Cognizant of the first director of space forces being fielded that year, he considered the role to be insufficient. This position was limited to providing space advice to an air professional. Here he called for a dedicated Joint Force space component commander to "lead and integrate theater space operations at a level equivalent with the other Services."[12]

In early 2021, the Secretary of the Air Force directed the USSF to establish Space Force service components for each combatant command. This partially satisfied Harter's proposition in that this action created a service component. US Space Command is concurrently considering designating their new space service component commander as the space theater Joint Force space component commander (JFSCC) as well. But this JFSCC has global space theater responsibilities.

This begs a question: Just how far should global space command and control extend into terrestrial theaters? As Harter delineates global and theater responsibilities, should there be both global and theater space component commanders with different, yet contiguous spans of authority? While not specifically labeling them, Harter points out that each JFSCC is unique, interdependent, and must be mutually responsive to the theater commander, be it a terrestrial and/or global combatant commander.

Space Unity of Effort

Hereto, Harter's propositions have been chiefly realized. Yet achieving intra-US government unity of effort remains elusive. Current efforts between departments, agencies, services, and organizations provide, at best, increased coordination between organizational stovepipes.

Harter mentions with hope the 2004 establishment of the National Security Space Office, which was to unite disparate efforts of military and civil entities, industry, and academia. But lacking authorities, this office failed. Even the USSPACECOM National Space Defense Center can only direct decisive action for the services while mustering a coalition-of-the-willing approach with the Na-

tional Reconnaissance Office. During times of conflict, the United States lacks a unified national space command structure.

Industry and international partners are frustrated. "Which US government (entity) am I working with?" "How many four-star generals must my general meet with?" These are common exasperations voiced during space security cooperation and startup companies' talks. As an attempt to provide clarity, nearly one-third of the 31-page 2020 *National Space Policy* is dedicated to outlining which department, agency, organization, or service handles which mission slice (fig. 1). At best, "in coordination with" describes how organizations should work together.

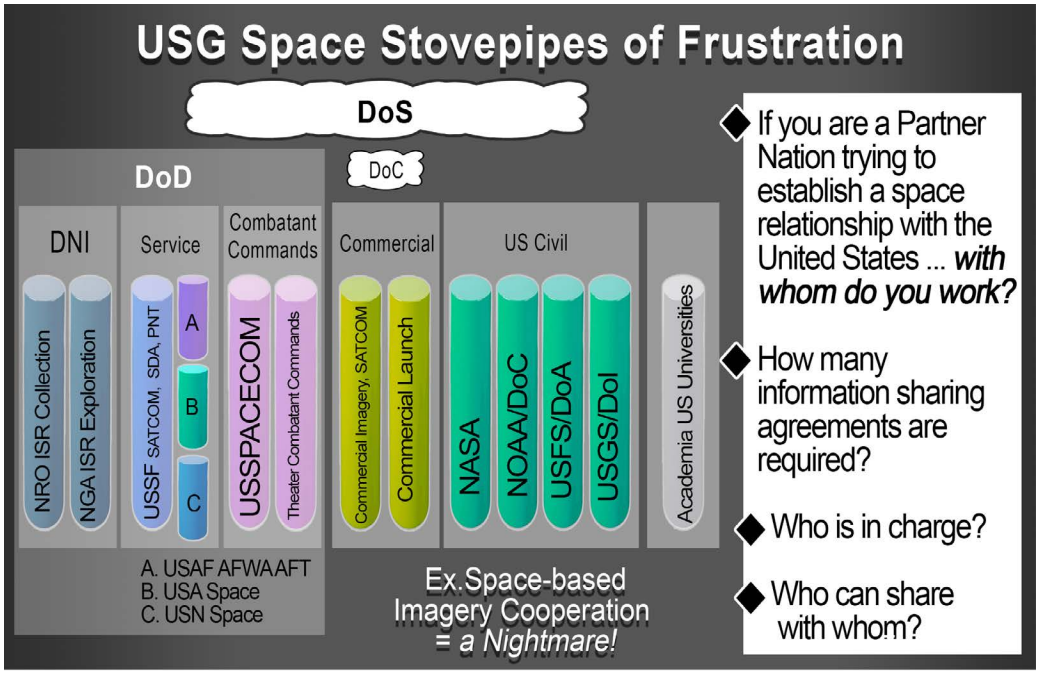

Figure 1. US government space stovepipes of frustration

For many international partners, a single orbital imagery collection pass or even a single image may be used for agricultural yield prediction, geological survey, law enforcement, infrastructure assessment, forest fire management, climate studies, and military surveillance. But collaboration with the United States in any of these specialized space applications requires independent formal agreements with each separate responsible department, service, agency, and organization.

Meaningful strategic-level unified direction was established when the Trump administration reactivated the National Space Council in June 2017. Council Chair Vice President Mike Pence drove a hard, principals-only stance that placed decision-making leaders together. This whole-of-government leadership assess-

ment and precoordination informed seven presidential space policy directives. Unfortunately, just as this focus enabled US, Ally, and partner talent to accelerate efforts, the United States is again losing unified strategic direction. In February 2021, the Biden administration announced that space policy directives would be replaced with national security memorandums.[13]

Separate, Independent Space Force

If progress in Harter's ninth proposition provides any indication, reaching our full national spacepower potential remains a work in progress. But the activation of the USSF on December 20, 2019, marked a significant milestone. Working across the US government, the National Space Council determined the need for a space force was evident. How quickly a space force was needed remained the question. A "Space Pearl Harbor" remains possible. But the situation requires a mindset akin to preparing for a "Space Battle of Britain." The United Kingdom's Royal Air Force had 22 years to organize its command and control, intelligence, surveillance, and reconnaissance industry, training, and operations to avert national calamity in 1940. In a race between a threat and generating a sufficient response, lead-time counts.

2018 and 2019 were propitious years. The 2018 National Defense Authorization Act re-established USSPACECOM as a space theater combatant command to drive domain dominant requirements. This set the stage for President Donald Trump's February 19, 2018, Space Policy Directive-3 order establishing the USSF.

In the succeeding years, US military space has been more Joint. A distinct new culture and a vision are emerging from what feels like decades of pent-up energies and frustrations. In short order, the new service established SpaceWerks, *Spacepower*—a capstone doctrine, the campaign support plan, the new Guardian *Ideal*, and Space Force service components. Given recent developments, the formation of USSF may have hit the sweet spot between technology, need, and opportunity in time to compete within the space domain.

Conclusion

Though not a principal source for all the propositions, Harter's "Ten Propositions Regarding Space Power" provided a succinct holistic view of the domain's strategic value and the efforts required to achieve space superiority. As such, it should be considered an intellectual contribution that helped fuel an emerging independent US military space effort.

Fifteen years later, Harter's work remains useful as an intellectual strategic outline against which to assess how we are meeting the challenges and reaping the

benefits of the unique domain. Since 2006, we have become more Joint and are working closely with a growing number of like-minded Allies and international partners. The national unity of effort still falls short of establishing and orchestrating a grand space strategy, and the US government still lacks a clear responsive launch vision. But for a strategic moment in time, we as a nation mustered sufficient focus to cross a threshold from which generations will benefit. ✪

Galen Ojala

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Notes

1. Mark E. Harter, (MITRE Support to US Space Force chief scientist), author interview, October 7, 2021.
2. Based on author experience as the Headquarters Air Force Space Command chief of strategy, doctrine, and policy from 2013 to 2014.
3. Brad Townsend, "Space Power and the Foundations of an Independent Space Force," *Air & Space Power Journal* (*ASPJ*) 33, no. 4 (Winter 2019): 14–15, https://www.airuniversity.af.edu/.
4. Carl A. Poole and Robert A Bettinger, "Black Space versus Blue Space, A Proposed Dichotomy of Future Space Operations," *ASPJ* 35, no. 4 (Spring 2021): 9–10, https://www.airuniversity.af.edu/.
5. Mark E. Harter, "Ten Propositions Regarding Space Power: The Dawn of a Space Force," *ASPJ* (Summer 2006): 24, https://www.airuniversity.af.edu/.
6. "The Space Foundation's Space Report Reveals Five Years of Growth for the Global Space Economy - $447 Billion + Counting. . .," SATNEWS, July 15, 2021, https://news.satnews.com/.
7. Headquarters, United States Space Force (USSF), *US Space Force Campaign Support Plan* (Washington, DC: USSF, May 2021).
8. Harter, "Ten Propositions," 71.
9. Harter, "Ten Propositions," 71.
10. Harter, "Ten Propositions," 22.
11. Michael Martindale and David A. Deptula, "Organizing Spacepower: Conditions for Creating a US Space Force," Mitchell Institute Policy Paper 16 (Arlington, VA: Mitchell Institute for Aerospace Studies, August 8, 2018), https://mitchellaerospacepower.org/.
12. Harter, "Ten Propositions," 73.
13. Sandra Erwin, "White House to Realign Responsibilities for Space Policy Oversight," Spacenews, February 5, 2021, https://spacenews.com/.

Lost in Translation: Innovating to Failure

Review of "The Use and Abuse of Technology: In Insurgent Warfare"

Jonathan Mahan

Translating military capabilities into political objectives has proven difficult throughout history. The events surrounding the recent US military withdrawal from Afghanistan echo in the minds of those who witnessed the fall of Saigon at the end of the Vietnam War. The drive to innovate lies at the heart of the greatest qualities of humanity and is particularly apparent in the speed of technological innovation within the United States. This retrospective will examine the relevance of Raymond Hain's 1999 article, "The Use and Abuse of Technology: In Insurgent Warfare," as it relates to today's focus on technological innovation to the exclusion of the human, social and cognitive domains.

Hain, among others, outlines in vivid detail the allure of new gadgets and their promise of military victory in Vietnam.[1] Hain's analysis of the challenges of translating technology to outcomes reveals three central points: (1) the context of conflict is highly important for successful means-ends alignment; (2) technology is limited in its efficacy for achieving political objectives and, in some cases, even detrimental to their achievement; and (3) in the age of information, narrative matters tremendously.

Two interrelated claims are central to these observations. One, the United States has a love affair with technology blinding it to the evolving context of

global competition; and two, this blind spot could prove fatal should the United States fail to make significant changes in how it innovates.[2] Awareness of the need for innovation is evident among senior leadership, as seen in US Air Force Chief of Staff General Charles Q. Brown Jr.'s initiative to "accelerate change or lose.[3]" These claims do not infer technology is no longer useful. But the drive for technological innovation may be elevated to a position incompatible with the state of world affairs. Examining Vietnam through Hain's article will aid in understanding this struggle to accept the limits of technology.

The Vietnam War—one of low-intensity conflict—proved to be significantly different than the conventional conflicts of the twentieth century to which the United States was accustomed. Hain defines low-intensity conflict as having four primary manifestations: counterterrorism, peace keeping, peacetime contingencies, and insurgency/counterinsurgency. Key unconventional aspects of this type of conflict include economic, political, and psychological warfare.[4]

A critical question many have asked is how the United States so impressively dominated the battlefield and yet lost the war. Hain offers a salient answer: the United States lost the war because of its love for military science and the neglect of military art.[5] US confidence in its mastery of military science and its blind faith in the promises of modern war-fighting technologies, are seen in the years leading up to the US invasion of Vietnam. This hubris leads to the second of Hain's arguments, that is, technology has its limits.

The French conflict in Vietnam lasted eight years. Rather confidently and subsequently erroneously, the United States did not consult the French about their hard lessons learned during the eight years prior to the launch of the US military campaign in Vietnam.[6] One possible explanation is that the United States believed its overwhelming military power did not necessitate a French consultation. Like France, America would have to learn the hard way. Technology has its limits, and the enemy gets a vote.[7]

The Viet Cong, learning from the enemy and adapting its military art, went to great lengths to avoid direct engagement with the better-armed French military forces. They traveled by night and engaged in short skirmishes against poorly protected French targets. If caught in the open, they would scatter and hide before the French could focus and mass artillery fire on their position.[8] The Viet Cong were able to negate the advantages offered by superior military science through asymmetric warfare. The military art adapted to fight the French offered even more promise for the Viet Cong and North Vietnamese Army when they encountered the US military.

Hain describes the US experience in Vietnam as a "bewildering disaster."[9] Key to this bewilderment was the realization that military success did not translate into

political success. The Johnson administration's stated goal was the creation of a stable, secure, noncommunist Vietnam, an objective that would prove too steep for even the world's mightiest standing military and its technology.[10] Hain includes a small sample of this technology: a bed bug operated "people sniffer," starlight scope, small personnel radar, sound detectors, and seismographs used to detect vehicles on a road. Special infrared detectors were used to locate heat sources beneath vegetation, and photographic films were used to identify dead vegetation.[11]

Many of these technologies failed to live up to their promise. For example, the XM-2 "People Sniffer" proved mostly useless during the war and was exploited by the Vietnamese who placed urine canisters throughout the jungle to lure US Soldiers away.[12] Even worse, rather than simply negating the US advantage, the Viet Cong and North Vietnamese Army succeeded in using the narrative these devices created against US political objectives. In this turnabout, the third and final point emerges—narrative may be the most potent weapon of all.

Speaking to the art of war, another critical US misstep in the application of technology was the destruction of Vietnamese rice fields in Operation Ranch Hand. Rice holds a special status in Vietnamese culture and to waste it was a cardinal sin. This turned normal peasants into active militants, exacerbating the US problem in Vietnam.[13] In 2011, Mark Clodfelter noted that in both Iraq and Afghanistan, the motivation for revenge in response to civilian casualties caused by the misapplication of military power was a particularly significant factor when measuring increases in enemy fighting strength.[14] Technology, when applied poorly at best or recklessly at worst can empower the enemy. Instead, the artful application of military science within conflict effectively links capabilities to outcomes.

Hain contends that throughout history, intervening powers overestimate the worth of their technology. Furthermore, these powers routinely fail to account for the needs and wants of the indigenous people.[15] Looking back at the conflict in Vietnam, then-US Secretary of Defense Robert S. McNamara argued the United States had gross deficiencies in its understanding of the Vietnamese people and their motivations.[16] The case for an American love affair with technology appears to have merit. Moreover, some studies suggest increased reliance on technology leads to a lack of awareness and connection with other humans and society.[17] Has the collective national strategic psyche become so wedded to technology that it has lost sight of the human component of warfare? The US military experience in Vietnam and more recently Afghanistan suggest this is a possibility.

The belief that overwhelming technological power can overcome deficiencies in its application is subtle and dangerous. Military science is no substitute for military art. An awareness of this lesson is particularly important in a world where the United States and its near-peer adversaries are approaching or have achieved

technological parity. The race to technological superiority could not be more urgent, and the United States must, of course, continue its pursuit of technological innovation. But these pursuits should not come at the expense of innovation in other areas, specifically, national cognitive capacity.

The 1983 report "A Nation at Risk," highlighted waning intellectual capital in the United States when compared to other nations. The framework of this report was directed specifically at national security and emphasized, "history is not kind to idlers."[18] The suggestion that intellectual complacency had penetrated US culture caused significant concern for the Reagan administration. Some would argue the problems highlighted in this report exist in America today.

Although education reform is beyond the scope of this short article, it speaks to a corollary lack of interest (or lack of ability, or both) in enabling meaningful change intended to bolster the intellectual capacity of the nation. Viewing the military as a sample size of the broader population suggests that getting to the root of the problem highlighted herein will likely require not only efforts within the Department of Defense, but prior to military recruitment.

In the age of asymmetric information warfare, cognitive deficiency may prove to be irrecoverable even by the best technologies. The Russian disinformation campaign directed at the 2016 presidential election is a clear demonstration of the artful application of information warfare. A nation armed with gadgets and deficient in ideas could prove highly vulnerable in the twenty-first-century global order.

The likelihood of an increasing number of conflicts similar to Vietnam is driven by environments in which these conflicts emerge: societies with extreme wealth disparities; societies with a nonexistent middle class; nations and regions containing key trade routes or land or maritime choke points; and less-developed nations with raw material or mineral resources ripe for exploitation by larger nations.[19] Globally, an increasing number of countries and regions meet these criteria. For example, since the recent US withdrawal from Afghanistan—a country rich in unexploited mineral resources, the Taliban has received offers of assistance from China.[20] Only time will tell if China will choose to brave the graveyard of empires.

Facing the near certainty of such conflict centered around asymmetric warfare, the US military must continue to master the science of war, but it cannot afford to do so at the expense of also mastering the art of war, a primarily cognitive domain. Investment begins in the intellectual capital within the nation as a whole, and continues as military leadership encourages bold innovation within its ranks. The type of innovation needed includes bandwidth and incentive for military members to garner educational and professional opportunities outside defense circles. The time for doing more with less and oversaturating war fighters with mundane tasks rather than sharpening their cognitive capacity is over. Should the

United States fail to learn from these expensive examples of the limits of technology, it may find itself in a conflict that could have been avoided with a more creative understanding of the concept of innovation.

Hain recognized the dangers of an overreliance on technological capability in the war-fighting domain. Contextually, this recognition appeared during a time during undeniable US technological superiority. If this perception of misplaced US allegiance to technological capabilities above all other forms of innovation is as pervasive as is feared, the dangers of such misapportioned capital cannot be overstated.

The character and speed of conflict in the age of information demands defense professionals think bigger and allocate every available resource to the mission of creating and retaining the broadest possible intellectual capital and perspective. Failure to innovate beyond the realm of technology may result in adversaries beating the United States in a race of which it was unaware. History is littered with examples of powerful characters outmatched by smaller, more shrewd ones. America cannot afford to add to that shameful, embarrassing lineage. True innovation demands more. ✪

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Notes

1. Raymond F. Hain, "The Use and Abuse of Technology: In Insurgent Warfare," *Air & Space Power Journal (ASPJ) Chronicles* (August 13, 1999), https://www.airuniversity.af.edu/.
2. Hain, "Insurgent Warfare," 7.
3. Charles Q. Brown Jr., *Accelerate Change or Lose* (Washington, DC: Headquarters, Department of the Air Force, August 2020), https://www.af.mil/.
4. Hain, "Insurgent Warfare," 2.
5. Hain, "Insurgent Warfare," 1.
6. Hain, "Insurgent Warfare," 6.
7. Mark Clodfelter, "Forty Five Years of Frustration: America's Enduring Dilemma of Fighting Insurgents with Airpower," *ASPJ* 25, no. 1 (2011), https://www.airuniversity.af.edu/.
8. Hain, "Insurgent Warfare," 5.
9. Hain, "Insurgent Warfare," 7.
10. Clodfelter, "Enduring Dilemma," 80.

11. Hain, "Insurgent Warfare," 8.
12. Paul Sorene, "The Vietnam War People Sniffer: Sweating Gets You Killed (1967)," flashbak.com, https://flashbak.com/; and "The 'People Sniffer' Goes to War in Vietnam," *New York Times*, July 16, 1967, https://timesmachine.nytimes.com/.
13. Hain, "Insurgent Warfare," 8.
14. Clodfelter, "Enduring Dilemma," 84.
15. Hain, "Insurgent Warfare," 14.
16. Errol Morris, "Review Essay: Vietnam, McNamara, and the Fog of History," *New Political Science* 26, no. 3 (September 2004): 461, https://doi.org/.
17. Anita L. Cloete, "Unstoppable: A Critical Reflection on the Socio-Economic Embeddedness of Technology and the Implications for the Human Agenda," *HTS Teologiese Studies/Theological Studies* 75, no. 2 (2019), https://doi.org/.
18. David P. Gardner, *A Nation at Risk: The Imperative for Educational Reform* (Washington, DC: National Archives, 1983), 10.
19. Hain, "Insurgent Warfare," 2.
20. Simon Constable, "Why China Wants to Get in on Afghanistan's Reconstruction," *Forbes*, August 28, 2021, https://www.forbes.com/.

China's Strategic Arsenal: Worldview, Doctrine, and Systems edited by James M. Smith and Paul J. Bolt. Georgetown University Press, 2021, 280 pp.

American leadership and doctrine also point to China as the primary military threat going forward, so it is essential that the United States better understand China's point of view. How do they view themselves, and how do they view Western military threats? In this context, *China's Strategic Arsenal: Worldview, Doctrine, and Systems* dives deep into China's strategic views, practices, and capabilities so that the United States may better understand them. The West cannot treat China like it did Russia during the Cold War, as China's nuclear doctrine and capabilities drastically differ, so this book aims to paint an accurate picture of China as a strategic power.

As the title suggests, this book is essentially a collection of nine papers on a variety of topics exploring China's strategic worldview, doctrine, and systems. James M. Smith and Paul J. Bolt, both professors at the United States Air Force Academy, selected the subject matter experts and ensured that they represented multiple viewpoints and interpretations of the facts.

While the authors come from the United States, Australia, and Japan, many of them speak, read, and research in Chinese and travel there frequently to engage with their Chinese counterparts. There was not a clear bias or uniform point of view among the collection, and each chapter was extensively researched and cited. Overall, the book is not trying to convince the reader of any one view. Instead, it lays out the facts and provides the context to understand them.

The book starts with the editors outlining the historical context for the US-Chinese relationship. This chapter walks through the events from before the Cold War until the Trump administration that summarize the US perspective toward China as a military power. This chapter could stand alone as a primer on the topic and is the most widely relevant section of the book.

From there, each chapter details a particular focus area. Andrew Scobell starts by examining Chinese strategic doctrine, including their No First Use policy, and how China sees the concept of deterrence differently from the West. Christopher Twomey continues that thread by describing how the Chinese deterrence concept has evolved to where it is now. Sugio Takahashi then provides a Japanese perspective to discuss the stability-instability paradox and how China's regional strategic stability should be considered.

The fifth chapter provides an overview of China's current nuclear systems and programs. Hans Kristensen uses tables and graphs to survey China's current stockpiles and future projections and goes on to describe their offensive and defensive capabilities in detail.

In the next chapter, Phillip Saunders and David Logan expand on China's nuclear capabilities by outlining their nonstrategic nuclear arsenal and their strategic, nonnuclear arsenal. They cover bomber and submarine-delivered systems, hypersonic technologies, counterspace options, offensive cyberattacks, and the future for artificial intelligence. While nuclear weapons are generally the focus of strategic power, China has many nonnuclear options to create strategic effects. This chapter did an excellent job summarizing China's military options.

In chapter 7, Bates Gill details the evolution of China's military organizational structure and how it has improved in recent years. He also introduces the concept of organizational entanglement and how the entanglement of nuclear and nonnuclear forces creates challenges for the United States.

China's current arms control and deterrence policies differ from the West's, and Nancy Gallagher describes how they have changed with recent American administrations in the eighth chapter. She outlines China's perspectives and assumptions about nonproliferation, strategic stability, and arms control and contrasts them to how the United States thinks about those topics.

The final chapter wraps up with an outlook for the future. Brad Roberts makes some predictions while acknowledging important uncertainties that make predictions difficult. Along with the introduction, the last chapter is the most generally applicable to readers. After reading eight sepa-

rate papers on China's strategic arsenal, the final chapter ties it all up nicely and summarizes the key takeaways from the different focus areas.

Be warned, this book is not a casual read. It reads like a collection of well-researched papers and is best read a chapter at a time to digest the details. Furthermore, if the reader is primarily interested in a particular focus area, there is no penalty for just reading the relevant chapter. The chapters occasionally reference others in the book, but they can easily stand alone.

China's Strategic Arsenal is worth reading for government and military leaders who need to better understand China's military capabilities and students in an academic setting, but it might be overkill for readers with a general interest in China. Overall, it was an extremely well-researched collection that painted a modern picture of China's strategic arsenal.

Captain Sean R. Kelly, USSF

Pearl: December 7, 1941, by Daniel Allen Butler. Casemate Publishers, 2020, 354 pp.

The attack on Pearl Harbor, a familiar story, can be clouded with myths and generalizations. *Pearl: December 7, 1941*, by Daniel Allen Butler, seeks to cut through these problems of history and ask "What happened at Pearl Harbor? What really happened?" Butler, the author of several published books on maritime history, engagingly tells the story and details the buildup to the infamous day the Empire of Japan attacked the United States, pulling the latter into World War II.

The story arc focuses on the great power struggle between Japan and the United States in the Pacific Ocean. The attack on Pearl Harbor is at the apex of this conflict. The author utilizes historical and strategic perspectives, with some limited tactical aspects, to dispel myths of the US-Japanese competition in the Pacific and the attack on Pearl Harbor. He also highlights little-known narratives and accounts of the buildup to December 1941, the attack itself, and the months that immediately followed. Butler provides a comprehensive overview of the historical setting with an exploration of centuries worth of Japanese and US history, briskly walking through the impactful events to set the foundation for a confrontation between Japan and the United States.

Pearl also explores the rise of militarism in Japan before World War II. The author contextualizes Japan's domestic and international policies through events where the Japanese felt cheated by Western nations. Butler also showcases how the Japanese experienced international alienation, both perceived and real, which influenced their cultural myth of invincibility and drove them to seek vengeance on Western powers. Through rapid industrialization and a drive to match Western military capabilities, the Japanese sought to achieve decisive victories against their adversaries. This dynamic was in the same vein as their remarkable feat at the Battle of Tsushima during the Russo-Japanese War in 1905.

In *Pearl*, interservice rivalry and bureaucratic wrangling within the military and national leadership of the Japanese and the United States were fomenters of action in this era. For Japan, the rise of a militaristic culture and the political dynamic were underpinned by partisan fealty to a military service and political party. According to Butler, the divisions within Japanese leadership drove aggressive foreign policy and championed domestic and foreign deception. The author also highlighted political machinations within US leadership circles. The derivative bureaucratic competition and interservice feuding all factored into US preparedness and response to the Japanese and impacted military readiness.

The author calls the larger Japanese military offensive in the Pacific during December 1941, the most audacious military campaign in history. While Japan attacked Pearl Harbor, the author noted the multipronged Japanese attack across the expanse of the Pacific Ocean sought to secure territory, resources, and prestige for Japan. Butler juxtaposed this strategic picture with first-person accounts to accentuate the dynamics of the era. The author relied heavily on a personal account of one of the architects of Japanese naval strategy and the Pearl Harbor attack, Admiral Isoroku Yamamoto. The

use of Admiral Yamamoto's story in the book helped to highlight the opportunities and issues Japan encountered through its rise as a power and decision to confront the United States.

The Pearl Harbor attack itself is at the core of this book. The author built the intensity and suspense of the attack, despite the reader's knowledge of the events to unfold. Through detailed paragraphs about the attack plans, the context behind individual choices and strategic decisions was profound. The reader could feel the anxiousness of the Japanese crewmen through the author's dramatic conveyance of the story. Vivid descriptions and minutiae of the attack itself, such as a US Naval Academy class ring found embedded in the bulkhead of one struck ship, truly emphasized a deeper more intense connection to the book.

Another topic the author highlighted to complete the narrative was the recovery of US service member remains. This aspect brought the heroics and horrors to the forefront through graphic descriptions of service members fighting to survive in near darkness in overturned ships and swimming through flaming oil slicks during the chaos of the attack. Some of the personal accounts were from the survivors themselves. In other cases, only the remains recovered in the following weeks and months could provide some semblance of understanding their story.

Throughout the book, the author also infused unique tales to tell a more complete story. The development of unique US and Japanese intelligence collection techniques, the planned use of Japanese midget submarines, and the nuances of diplomatic communications, all contributed toward a richer comprehension of what happened at Pearl Harbor. *Pearl* is an engrossing read on a well-tread but important subject. *Pearl* will interest readers new to this history and satiate military historians.

Captain Robert Marshall, USAFR

Power after Carbon: Building a Clean, Resilient Grid by Peter Fox-Penner. Harvard University Press, 2020, 430 pp.

Ten years after his popular work *Smart Power*, Peter Fox-Penner returns with an updated and companion piece, *Power after Carbon: Building a Clean, Resilient Grid,* on the country's transition from fossil-fuel-powered electricity generation to carbon-neutral sources. Substantial technological progress has been made in the areas of power generation and energy efficiency.

Fox-Penner's new research focuses on the challenges both to the electric grid to compensate for the inherent inconsistency in power output from renewable sources and to the electric utilities to make this transition while remaining profitable. Fox-Penner does a commendable job of providing insight into the inner workings of an industry most take for granted. He astutely avoids forecasting the precise details of the transition but thoroughly investigates and then recommends pathways to achieve zero carbon emissions from electricity generation by 2050.

While *Power after Carbon* tackles technical subject matter, it builds an understanding of the electric power industry from the bottom up. Fox-Penner's finesse in enabling the reader to understand this specialized subject matter likely comes from years of experience educating students and industry professionals. He is a professor of Practice at the Boston University Questrom School of Business and the founder and director of the school's Institute for Sustainable Energy. He is also a partner and the chief strategy officer of Energy Impact Partners and maintains ties with the Brattle Group, where he worked as principal and chairman for 20 years.

The first chapters of *Power after Carbon* focus on the existing and emerging technologies that will transform the production and consumption of electricity. As more vehicles and appliances run on electricity instead of fossil fuels, energy efficiency will need to increase to prevent ballooning electricity consumption.

US electricity consumption peaked in 2007 and has since declined 8 percent. Fox-Penner notes that "this trend is even more remarkable because it has occurred during a time when real electric-

ity prices have been going down, not up," and he suggests that innovations such as net-zero buildings are likely to continue this trend (16). California, for example, has required all new homes to be net-zero as of 2020 and will widen this requirement to include commercial buildings in 2030. A decrease in the cost of photovoltaics and an increase in the efficiency of household appliances such as air conditioners and water heaters has made this mandate possible.

These developments, coupled with local battery storage, could lead to a "local power" trend, but Fox-Penner points out that the "Big Grid" will still benefit from economies of scale and will still be required to temper the swings in energy production from renewable sources. An investigation of how balancing authority areas (BAA) currently operate to satisfy supply and demand and what will imminently be expected of the BAAs reveals forces that favor a geographic expansion. Parts of the United States, for example, have much more potential for renewable energy production than others. Large-scale storage projects, such as pumped-storage hydroelectricity or heat storage, will be far less expensive than multiple lithium-ion batteries for meeting peaking energy needs.

Given recent high-profile hacking events, Fox-Penner presciently considers the small versus large debate through a cybersecurity lens. He notes that essential users, including US military bases, have embraced a "cyber-secured microgrid" concept to external vulnerabilities. He warns, however, that "microgrids can function on their own only because they have extensive sensing control and communication networks that work without long latency or interruption" (87).

These networks create vulnerability to all associated microgrids even though the grids are physically isolated. Moreover, the small governments or organizations that tend to run microgrids likely do not have the resources to invest sufficiently in security or to deal with the repercussions of a hack. Fox-Penner concludes that the United States will see a trend toward smaller grids over the long term, But in the coming decades, the safe transition to carbon neutrality will largely depend on the preservation of the Big Grid.

Utility companies now find themselves in a challenging situation. Fox-Penner asks, "What do you do when the only way to earn the profits that are built into prices is selling a product whose sales are flat to down" (176)? Utility companies have recently done quite well by investing in renewables and smart-grid technology, creating additional revenue streams. Fox-Penner revisits the concepts of Smart Integrator (SI) and Energy Service Utility from *Smart Power* as emerging business models and expands them into a spectrum of customer engagement. He considers several examples of electric utilities along this spectrum and examines the unique regulatory challenges and the potential to facilitate a transition to clean energy. The SI model combined with separate energy service companies that interact directly with the consumer seems to show the most potential to leverage cutting-edge technology. This model would thrive in an environment where "prosumers" generate much of their electricity and where artificially intelligent algorithms can provide individualized services.

Fox-Penner concludes *Power after Carbon* with an appendix of policy recommendations, all focused on a goal of net-zero greenhouse gas emissions to zero by 2050. Many of the recommendations are not clear-cut mandates. On the topic of utility business and regulatory models, he states that nations, states, and utility companies must consciously choose a model but does not prescribe a one-size-fits-all solution. The transition to a clean power grid will not be simple, but *Power after Carbon* will help consumers, regulators, and business professionals alike to make educated decisions.

First Lieutenant Frederick Metzger, USAF

War at the Speed of Light: Directed Energy Weapons and the Future of Twenty-First-Century Warfare by Louis A. Del Monte. Potomac Books, 2021, 269 pp.

Modern warfare can be characterized by the compression of battlefield time and space resulting in rapid resource attrition and the need to react faster to adversary actions. *War at the Speed of*

Light by Louis Del Monte provides a top-level survey of strategic options incorporating faster weapons, the technical capabilities for directed energy weapons, and what future wars may look like if these weapons are fielded.

The book first examines US offset strategies and progress toward implementing fourth offset goals. Each weapon category, from laser to cyberspace, appears with a detailed technical description as well as US and adversary progress toward fielding battle-ready options. The final section examines the potential of autonomous weapons and considers what directed-energy fights across the ultimate high ground of space may entail. Del Monte's book is an easily read overview for those interested in future technologies and should be on the read list for those studying the art of war, potentially making a good mandatory read for those in some Space Force basic technical schools.

The central theme behind *War at the Speed of Light* is that electromagnetic spectrum weapons rather than physical projectiles should be a core component of any forward-looking US strategy. The book does not advance a thesis or tested point but instead presents the strengths and weaknesses of these weapons. The core discussions consider means rather than ends, leaving out any potential operations employing speed-of-light weapons. While various scenarios are discussed, most are on a personal basis versus a military use case. There is no direct comparison between US and adversary systems. Therefore, the book is a primer on potential possibilities rather than a full evaluation of which systems are preferential for future military success.

The first section addresses the four US offset strategies from a chronological perspective. The first offset strategy was deterrence as characterized by nuclear Cold War options, including mutually assured destruction and other nuclear strategies. The second offset strategy emphasized precision when laser and GPS targeted weapons appeared in the first and second Gulf Wars. Transitioning to the third offset began under President Barack Obama with the Strategic Capabilities Office and increased funding for the Defense Advanced Research Projects Agency. This strategy sought technical advances by reaching out to commercial partners to field the most modern technology.

The fourth offset started with President Donald Trump and included three changes to the previous offset. It recognized China and Russia as the greatest threats to US national security, emphasized directed-energy weapons as essential, and secured alliances as an asymmetric strategic advantage. Each offset had an advantage when it was proposed. It remains to be seen whether the US will remain committed to the newest change or seek a different offset.

After establishing a strategic framework, Del Monte looks at four directed-energy weapon categories: laser, microwave, electromagnetic pulse, and cyberspace. In the laser category, the author primarily examines blinders but also touches on the US Navy's antidrone capability. Not mentioned are the US Army's recent acquisitions, including the Multi-Mission High Energy Laser and the Stryker-mounted air defense systems.

The author next introduces microwave weapons–especially their use for crowd control through the neurological impacts possible. An excellent example appears with the Cuban use of these weapons against the US embassy in Havana that caused physical illness, vertigo, and some sensory damage. Electromagnetic pulse weapons, the third category, use an intense burst of energy to nullify electronics. These effects are referenced as created from a secondary effect of nuclear explosion vis-à-vis an independently fielded weapon.

The final weapon category, cyberspace, encompasses a broader field although the author mentions more traditional electronic attacks like the jammers employed by the EA-6B Prowler. I consider cyberspace weapons too diverse to adequately cover in a single chapter as a subcomponent of directed energy weapons due to the many options with directed effects, hunting systems, and intelligence options. Del Monte spends a paltry 23 pages in two chapters examining defensive options as standard electronic countermeasures before mentioning active defense systems to protect from either kinetic projectiles or electromagnetic radiation. Each element of the technical capabilities is sufficiently referenced to allow readers to seek out more detailed data from other sources.

The final section explores the technological near future by characterizing the challenges posed by autonomous weapons and killer satellites. Del Monte mentions the ethical dilemmas associated with weapons picking their targets and what could happen when weapons can strike faster than the longer, human-driven kill chain required by today's autonomous weapons, such as the Tomahawk cruise missile.

Left out is the discussion of whether a fire-and-forget weapon is an autonomous option or simply improved aiming. Space weaponization suggests the potential for satellites to maneuver to physically destroy an adversary or perhaps for particle beam employment. High velocity in orbit means that any object capable of navigation could be used as a kinetic weapon. Particle beams use high-energy directed weapons with increased effectiveness because of the absence of any atmospheric interference. Del Monte concludes with three guidelines for future war: (1) nuclear weapons should be eliminated, (2) autonomous weapons should be used solely under close human supervision, and (3) all autonomous weapons should employ only conventional warheads.

War at the Speed of Light offers a generic look at future capabilities. The biggest limitation is the concentration on isolated tactical employment versus a strategic or combined arms perspective. Each section introduces the topic but lacks depth on how the weapons might be employed or where they would instead serve as a force multiplier.

Overall, *War at the Speed of Light* offers a good introduction to those whose background in the area is lacking. The summary of the US strategic offsets is excellent. The technical capabilities, offensive and defensive, provide enough detail for the reader to find other sources to seek more detailed knowledge. Lacking any comparison of how the different weapons might be employed in a combined arms strategy, the final section fails to muster sufficient emphasis to serve as a true guideline for a way ahead when considering the proposed weapon systems. The book provides an excellent starting point, and I would recommend it for those new to the study of war or looking to begin researching directed-energy capabilities.

Dr. Mark T. Peters II, USAF, Retired

War's Logic: Strategic Thought and the American Way of War by Antulio J. Echevarria II. Cambridge University Press, 2021, 308 pp.

War's Logic proceeds from the basic premise that war has a logic and that by learning the "grammar" of past conflicts, one is better armed for the future. This publication is a rare resource to military professionals offering not only valuable context for military strategy but also enjoyable reading on US history. For 10 chapters, the author argues that war's nature can be viewed in distinct paradigms proposed by successive twentieth-century strategists. Paying equal tribute to luminaries' personal lives and professional accomplishments, the book gives readers a vocabulary to appreciate American strategic thought and speak more intelligently about war.

Antulio J. Echevarria II is uniquely qualified to write a book that makes such lofty promises to the reader. He is a professor at the US Army War College, former Elihu Root Chair of Military Studies, and editor in chief of the US Army War College Press. His publication is evidently the culmination of a career of research and extensive teaching experience.

War's Logic flows chronologically in four parts from the early principles of war to modern operational art. Each part focuses on two to four key intellectuals who left their imprint on US strategic doctrine. Interwoven with a discussion of the evolution of US strategy is an approachable overview of general American history to provide context. After all, the book is US-centric, so a presentation of American developments in each era is key to understanding the background of strategic thought.

The following is just one small example from Echevarria: "1957 was the year in which . . . Kissinger's *Foreign Policy and Nuclear Weapons* appeared, the Soviets launched Sputnik I and II into

orbit, and Elvis's 'Jail House Rock' energized a generation" (144). Current events in the United States add a splash of color to an otherwise dense read focused on the military aspect above all.

War's Logic pays substantial attention to innovative thinkers in the Navy and Army. Part of this is no doubt because, before 1947, the Air Force as such did not exist. Still, it is most likely healthy for Air Force professionals to read from a viewpoint that is not overly deferential to icons of Air Force history. Joint operations are the current reality, so Air Force professionals will be better off having a background on key historical figures of the battlefield and sea. Furthermore, Echevarria does not hold any punches with a few icons of Air Force history. Billy Mitchell, for example, is equally lauded for his idea to establish a unified air service and dismissed as a vainglorious, pig-headed personality whose court-martial was a tabloid fixture for months (33). In many Air Force curricula, heroes of airpower are depicted through a rose-colored lens; it is refreshing to find a portrayal that shows airpower legends, warts and all.

Unsurprisingly, Carl von Clausewitz—military theorist, oft-cited luminary, and forbearer to modern discussions on war—looms large in most chapters. Clausewitz's principles of war are, after all, the archetype for modern discourse, and few conversations evade his ample contributions to the field. Interweaving Clausewitzian observations, the author thoughtfully organizes his book around chronological contributors to military thought and their ideas and publications. A typical chapter summarizes an individual's contributions, presents their life from upbringing to military career, and digests their publications and key contributions to war's logic.

Echevarria is skillful at connecting the dots in each chapter and among the evolving theories of war in the twentieth century. With each chapter standing alone, one can jump in at any point in the book, starting where one is most interested. Additionally, the text is approachable, written for laypersons, and with several foundational terms that practitioners will recognize from any professional military education course. For example, most Air Force professionals will recognize the concept of "DIME": diplomatic, information, military, and economic power as tools of state power in the chapter on Henry Eccles (116). Additionally, most any Air Force professional already knows the OODA (observe, orient, decide, act) loop, one of numerous contributions from Colonel John Boyd (169).

War's Logic is an important read for Air Force professionals because it illustrates the development of airpower from its earliest days to the present. It also takes a step back to describe how political, economic, and diplomatic dimensions complement military offensives. What better way to do so than through the views and shifting doctrine of past prominent thinkers in the armed forces? The author emphasizes the thought that future practitioners "will surely develop other models of war's nature" (227). In so doing, he invites readers to consider the next potential strategic models.

One has the distinct impression that with his doctorate from Princeton University and more than 20 years of teaching experience, Echevarria could speak to an audience about military history or the development of airpower with little or no preparation. But that is not to detract from the accomplishment of writing this book, which serves as an excellent jumping-off point for advanced study. Further, while *War's Logic* is backward-looking rather than predictive, this too is not necessarily a weakness. *War's Logic* limits its scope to the past and adequately delivers on what it promises. It is a historical analysis and not necessarily a roadmap for the future. Any complaint that it does not presage the future would be unfair.

Echevarria brings his book full circle with a colorful quote: "If war is a continuation of politics by other means so, too, is thinking about war" (227). While this quote is praiseworthy, it is hard to square it with the opening quote from Clausewitz: "Is war not just another form of expression employed by peoples and governments? Indeed, war has its own grammar but not its own logic." Thus, for Echevarria to title his book *War's Logic* is to expressly accept Clausewitz's challenge: to write out war's grammar in furtherance of finding its logic. This goal may be a fool's errand since

many have observed that the act of war is inherently illogical. Still, the lessons and experiences from past theorists bring us closer to something resembling logic in wartime.

Captain Matthew H. Ormsbee, USAF

Planning to Fail: The US Wars in Vietnam, Iraq, and Afghanistan by James H. Lebovic. Oxford University Press, 2019, 315 pp.

The recent collapse of the Afghan National Army and subsequent flight of US personnel from Kabul signifies the frustrating end to a once popular, even honorable, endeavor. The ensuing media firestorm over American blunders in Afghanistan and the greater Middle East articulated many compelling points, but a deeper analysis is needed to fully comprehend the essence of this tragedy. Fortunately, professor and author James Lebovic provides that with his new book *Planning to Fail: The U.S. Wars in Vietnam, Iraq, and Afghanistan*. The author convincingly demonstrates the hidden biases and nonrational tendencies that hinder American policy makers from making pragmatic decisions.

Lebovic is uniquely well-equipped to write on the subject. In addition to teaching political science and international affairs at George Washington University, the author served as chair of the International Security Studies Section of the International Studies Association for several years. He is also the author of five additional books on national security topics.

His most recent contribution, *Planning to Fail*, is ambitious in scope, addressing three conflicts—Vietnam, Iraq, and Afghanistan—now ingrained in the American psyche due to their complexity, duration, and disappointing results. This book is not the only one to draw on these conflicts to better understand national security pitfalls. Donald Stoker's *Why America Loses Wars: Limited War and US Strategy from the Korean War to the Present* and Brendan Gallagher's *The Day After: Why America Wins the War but Loses the Peace* also reflect on the failures of recent US endeavors. *Planning to Fail* is unique, though, for its focus on decision-making theories and a synthesis of lessons for future policy makers.

Lebovic's overarching thesis is succinct: policy makers are myopic. Instead of carefully considering long-term policy goals, governmental actors succumb to the tyranny of the urgent. Lebovic establishes four stages of decision-making found in all three conflicts to support his thesis.

Stage I includes the planning and initial commitment of military forces. This initial commitment is then extended and expanded in Stage II. Eventually, policy makers reach their limit and restrict the flow of resources in Stage III. By Stage IV, withdrawing from the conflict has become the objective. Lebovic argues that in Vietnam, Iraq, and Afghanistan, nonrational influences dominated the four-stage process, resulting in a shortsighted policy.

The bulk of the book, contained in three chapters, is dedicated to a detailed analysis of each conflict. Lebovic methodically constructs his arguments through these case studies. The author's careful consideration and ultimate refutation of opposing viewpoints is a testament to his thoroughness, and his dispassionate and impartial approach to politically or emotionally charged topics and individuals was refreshingly professional. The choice of the conflicts themselves was also wise; the four stages of wartime decision-making were readily apparent in each, strengthening the intellectual framework through which to consider the arguments. In sum, the author's meticulous and unbiased approach lends a credibility not easily found in other works.

Lebovic addresses the Vietnam War first, and in doing so presents perhaps his strongest arguments on nonrational decision-making. One by one, he debunks common misconceptions, showing that the Johnson administration had every chance to stop involvement but willingly—and unwisely—chose to stay the course. The author claims that "what makes rationality suspect here is, not what option the administration selected but how it selected it." The arguments between John-

son and his advisors always centered on how many troops to send or how many targets to bomb, with little consideration for how these efforts helped achieve end goals.

The Iraq and Afghanistan conflicts present unique challenges to a researcher due to their recency, but Lebovic's efforts are nonetheless credible. Undue optimism and an aversion to nation-building within the Bush administration handicapped early efforts. Later, both the Bush and Obama administrations placed excessive focus on troop levels and departure timelines, clouding strategic thinking and limiting available options.

Here it becomes painfully obvious that political leaders could have avoided the four stages of wartime decision-making "by pursuing goals that suited US capabilities or avoiding no-win wars in the first place," but they chose not to. Lebovic thus shows that the condition of myopic bias at the highest levels of government remains a painful issue into the twenty-first century.

There are, however, modern conflicts indicating some level of foresight and restraint in American leadership. US operations in Somalia, for example, were abbreviated in 1993 after the bloody Battle of Mogadishu. The NATO air campaigns in Bosnia and Kosovo, spearheaded by the United States, also remained limited and intentional.

The most famous example is undoubtedly the first Gulf War when coalition forces liberated Kuwait and battered Saddam Hussein's military without succumbing to mission creep. Lebovic does not necessarily discount these examples—the first Gulf War is mentioned briefly—but a thorough analysis of these conflicts might reveal compelling instances of government actors overcoming myopic biases.

This is not to say that Lebovic fails to provide policy prescriptions. On the contrary, the final chapter is dedicated to learning from the failures chronicled throughout the book. Here, Lebovic is at his best. "War is *always* a matter of choice," he claims, and US interests "always reduce to matters of quantity, not fundamental quality."

The fact that each policy maker examined here resisted questioning and debate, instead moving quickly or unthinkingly toward action, reveals the dangerous pull and ultimate consequences of myopic bias. Fortunately, Lebovic leaves readers with lessons to be learned from each of the four stages of decision-making. He also provides eight additional lessons for policy makers to help mitigate the effects of bias.

Planning to Fail remains an excellent critique of US decision-making in Vietnam, Iraq, and Afghanistan. Lebovic's contribution to the debate is sorely needed, not only for the criticism it offers but also the guidance it gives to present and future national security leaders. Recent events show that the dangers of myopic biases did not end with Vietnam. Sadly, unless more attention is paid to the lessons presented by Lebovic, they likely will not end with Afghanistan either.

Second Lieutenant Mark Schell, USAF

On Contested Shores: The Evolving Role of Amphibious Operations in the History of Warfare edited by Timothy Heck and B. A. Friedman. Marine Corps University Press, 2020, 395 pp.

With the threat of near-peer warfare becoming closer and closer, there has never been a better time to reexamine the importance and nature of amphibious warfare. Timothy Heck and B. A. Friedman answered the call, editing inputs from 20 authors to the anthology: *On Contested Shores: The Evolving Role of Amphibious Operations in the History of Warfare*.

Heck brings the practitioner's experience as a former artillery officer and Friedman the theorist steeped in research. Friedman holds a master's in security and strategic studies from the US Naval War College. Together, the editors' detailed collection is accessible to the war fighter.

The book leads the reader through amphibious operations from sixteenth-century Tuscany to the Information Age and even future amphibious operations. Similar recent publications include *Strategic Water: Iraq and Security Planning in the Euphrates-Tigris Basin* and *Raging Waters: China,*

India, Bangladesh, and *Brahmaputra River Politics*. While these works address amphibious operations in the Middle East and Southeast Asia, respectively, the text in this review focuses on the role of amphibious warfare from a Western perspective.

Heck and Friedman posit that the nature of amphibious warfare has changed throughout history, yet its importance has persisted. Despite some critics' claim that amphibious operations are facing imminent death, the authors argue that these operations are approaching a period of heightened significance.

Where most historical texts focus on landmark battles such as Normandy and Gallipoli, this book seeks to illuminate often overlooked events. Each chapter is written by a different author, a strategy that allows efforts to be highly concentrated. Illustrations throughout the book are given to orient the reader to the tactical-level movement in the context of the strategic and operational environment.

Dividing the text into distinct time periods supports both elements of the thesis. It shows the reader the extent to which amphibious warfare changes by creating clear separations between operations in a different time period. This organization also shows that amphibious operations have been crucial throughout the majority Western history.

The reader can make a host of profound implications by pairing this book with other works in the field. First is the changing nature of the Marine Corps. The *Force Design 2030* depicts an experimental future Marine Corps. The author challenges the force to gather intelligence, adjust resources and execute simultaneously. As shown in the book, amphibious victories predominantly came as a result of the victor outwitting the enemy. *Force Design 2030* is the Marine's methodology for maintaining this advantage in the twenty-first century.

Second is the changing nature of military operations in general. Heck and Friedman explain that amphibious operations are inherently joint. Thus, it stands that all services will adopt methodologies to make them nimbler while staying connected. The Air Force has championed this goal, as evidenced by the coveted Joint All-Domain Command and Control and new mission command structure: centralized command, distributed control, and decentralized execution.

The third implication is a rise in the frequency of amphibious operations. The authors cite increased sea lines of communications as a result of climate change. This is occurring in concert with the increased threat of Russian and/or Chinese aggression. Since both adversaries are unlikely to attempt a conventional war, skirmishes will most likely occur on third-party islands. The United States increased funding and mobilization to arctic areas in preparation for this contingency.

The authors support the thesis in a detailed manner, yet the book could be more impactful if the battles included amphibious warfare in Eastern countries. The intent is stated to "give historians, theorists and practitioners an opportunity to . . . find out what it takes to win on contested shores."

China is potentially the highest contested shore the United States may face. The diverse author corps does not seem to include many specializing in Western versus Eastern warfare. A historic Sino-Western naval battle would lend the reader to understand China's amphibious operations in the context of their different culture. For example, the Battle of Lake Poyang in China shows how a significantly outnumbered rebel force succeeded by burning the incumbent emperor's ships filled with gunpowder. China's Belt and Road Initiative is analogous to the ancient Silk Road. It is feasible that future Sino military tactics may mimic historical naval victories.

This book is crucial for historians, theorists, and practitioners. It should be mandatory reading for all service members participating in Joint intermediate developmental education assignment. Personally, it is the clearest depiction of how strategic and political goals led to tactics I have seen. Many of the illustrations are organized in a manner not unlike a conventional mission planning cell.

The authors do an excellent job translating the host of acronyms involved with amphibious warfare. There is a dedicated acronym page before the introduction. This text would be invaluable for any field grade officer looking to participate in, or along with, amphibious operations. It may

serve as an excellent historical textbook to help students see that amphibious warfare transcends singular time periods.

Captain Gregory Search, USAF

Rebranding China: Contested Status Signaling in the Changing Global Order by Xiaoyu Pu. Stanford University Press, 2019, 152 pp.

Author Xiaoyu Pu is an assistant professor of political science at the University of Nevada-Reno. This book is part of a series addressing diverse contemporary security challenges in Asia. In *Rebranding China*, the author claims that China has a duality status struggle—resulting from its rapid growth and development—that receives little attention by scholars and practitioners. Is it a developing country, a benign regional leader, an aspiring global leader, an unwilling global leader, or an emerging superpower? Is it playing a zero-sum game with the international community or growing within the existing global order?

The author asserts that China projects mixed messages to its domestic and international audiences and needs to better articulate its preferred status. Pu believes that how a country crafts its preferred image is vitally important. Sending mixed or confusing status signals can lead to geopolitical friction, distrust, and deep suspicions of China's real intent by its own people and the global community at large.

The author meticulously builds a case for China's poor status signaling by presenting many examples of how China exhibited confusing and sometimes contradictory foreign policy practices. He notes that China has a multiple audience dilemma, which gives incentives to maintain several identities with conflicting roles. China wants to be loved and feared at the same time. The challenge facing China is that all its audiences receive China's status signaling at the same time.

China presents a rapidly rising and emerging power image to its domestic audience but a developing country image to international audiences. It demands accommodation on geopolitical interests such as the Spratly Islands and South China Sea claims yet wants to be considered a developing country on economic matters. When seeking opportunities from international institutions, China uses emerging-power status (its strengths in resources, population, and economy) while at the same time shirking social/welfare responsibility to the global community when convenient, thus emphasizing its weaknesses as a developing country.

Pu explains that China wants depth of interconnectedness with its neighbors, thereby creating reliance on and interdependence with China. China sends two messages within East Asia. The first is "don't fear us," and the second is that China's rise mutually benefits its neighbors. China professes to bring peaceful order to the region through multilateral economic and security institutions such as the Shanghai Cooperation Organization, the Asian Infrastructure and Investment Bank, and the Belt and Road Initiative.

China claims it does not seek to overthrow the existing world order. After all, it is a primary beneficiary of the international system. However, the author notes that China is becoming more politically aggressive in regional/global posturing. It frequently leverages self-serving statecraft on national interest in an assertive and coercive manner with its neighbors. China is fearful of a US military presence in the Asia-Pacific region and wants Asian security left to Asians. A problematic by-product of China's haphazard status signaling is evidenced by how the United States interprets it. The United States sees China wanting to displace a US presence in the Asia-Pacific by expanding its global economic/security influence and being the regional hegemon. This is leading the United States to rethink its strategy toward China.

Pu ultimately views China as a rising power with minimal threat to the global community. China sees its domestic image as more important than its international status. The author suggests that a rising power's domestic audience is more important than its international audience. China's

status signaling is contested because the country's population and leadership do not have consensus on China's position on the world's stage. The Chinese Communist Party (CCP) promotes the idea that it is the only legitimate political force that can defend China's honor and the only entity capable of holding China together.

The author believes that for China to compete as a rising power with the United States, the CCP/China should be a better leader in the international normative order. Being a better leader entails a well-communicated grand strategy supported by policies that reflect the strategy in both action and intent. China's dilemma is how it must project an international image of conflicting roles in ways that promote its national interests without antagonizing or sending misperceptions that result in mistrust and fear by its own people, neighbors, and the world at large.

Pu superbly supports his thesis through countless well-articulated examples drawn from the literature and thought-provoking analysis. Arguably, the most notable contribution the author makes to the body of knowledge is in introducing status signaling into the international relations literature. His signaling model, supported by his rigorous examination and application, helps frame how foreign policy behaviors are shaped by rising powers. It can also be seen as a means for information communication to appropriate political figures to either change or continue various status beliefs they may claim.

This book is best read by international relations/affairs, political science, and Chinese scholars as well as applicable governmental entities, including military leaders and Asia-Pacific specialists. It is also a relevant read for those interested in learning how rising powers struggle to shape their domestic and international identity and grow from their mistakes.

Dr. David A. Anderson

Russia Abroad: Driving Regional Fracture in Post-Communist Eurasia and Beyond edited by Anna Ohanyan. Georgetown University Press, 2018, 200 pp.

When I was in high school, during the long-ago 1990s, my geography teacher had the class color a map of Europe using different hues to delineate regions. He specifically instructed us to color a portion of Eastern Europe dark red and label it the "shatter belt region," a geographic area defined by the cultural and political clash of Western Europe, Russia, and the Arabic/Ottoman Middle East.

A decade later, numerous reports and articles announced the dangers of "failed states," ungoverned or lightly governed spaces that lacked the ability to police themselves, often harbored terrorists, and spread chaos throughout the regions in which they festered. Then, just a couple of years ago, we heard the warning of "frozen conflicts," internal warfare or proxy combat that delegitimized any attempts a given state takes toward maintaining a central government, typically in the context of Russian actions in former Soviet states.

The generational irony undergirding each of these labels is the seeming inevitability of globalization and increased regional interconnectedness that defined the era. These failures of governance, no matter the label, seemed an anachronistic outlier. After a generation in which the reality of state and regional fracture has not lessened, however, one has to wonder: Will the global community always be bedeviled by the specter of failed governance projects?

Anna Ohanyan, editor of this collection of essays titled *Russia Abroad*, argues yes. Failed or fractured states have existed for as long as we have sought to define the nation-state, a type of photo negative of those qualities we assess "successful" states in the international order to possess.

Ohanyan, a distinguished professor of political science at Stonehill College, believes that we should concern ourselves less with how fractured states buck global trends toward interconnectedness and more with understanding the factors that drive fracture within the state.

At their core, fractured states lack the intergovernmental reach, resiliency, and respect to execute full governance within their borders, thus preventing the establishment of a future foundation for regional connections that reach beyond, and through, borders. While Ohanyan advances a holistic theory that, she believes, one can apply globally to understand troubled regions, the focus of her current work, as the title suggests, is on the "new" concept of regional fracture or frozen conflicts in Russia's near-abroad. The actions taken by Putin's Russia to destabilize its neighbors, while significant in the moment, are indicative of a set of centuries-long Russian/Soviet imperial policies that look to incorporate these borderlands into a greater Russian empire, contributor Robert Nalbandov states.

Although these policies intended to capture these regions in Russia's imperial sphere, they also weakened local governance to preclude any revolutionary or separatist movements. This internal weakness persisted in the wake of the Soviet Union's collapse and set the conditions for Russia's reentry, desired or otherwise, into the region during the 2000s and 2010s.

While most contributors outline the role that recent Russian actions have played in destabilizing Eastern Europe, the Caucasus, and Central Asia, they also highlight other trends that contribute to state and regional fracture. They point to the outsized role played by nongovernmental organizations, moneyed and cultural elites, refashioned or recast histories, and persistent cultural norms in maintaining or exacerbating state weakness and regional fracture.

Contributors all extended this model beyond Russia's near-abroad, examining how Russia's continued neo-imperial reach emphasizes long-simmering feuds and political instability. Dimitar Bechev (Western Balkans) and Mark Katz (Syria and the Levant) overlay Ohanyan's theory of regional fracture with the other contributors' Russo-focused theory of the legacy of Russian overreach, giving legitimacy to Ohanyan's framework in areas beyond the post-Soviet hinterlands.

At times, the authors unwittingly also illuminate areas where the reality of state fragility and regional fracture draw similarities across seemingly unlike groups. In one of the most striking examples, David Lewis charts how the rise of illiberal regionalism provides a means for the states of Central Asia to create an identity in the chaos of post-Soviet fracture and neoliberalism (119).

"Illiberal regionalism" is defined as how the "focus on the role of shared ideas, norms, and beliefs provides a framework for some limited regional cooperation with a common discourse that is sharply at odds with the liberal norms that underpin most of Western theories of regionalism." As Lewis notes, this regionalism often comes with the ascension of authoritarian "strongmen" who rely on a masculine, ethnographic sense of cultural unity in the face of uneven economic and social change. The perceptual rise of authoritarianism and illiberal democracy across the globe would seem an extension of what Lewis describes. Plumbing the depth of this thinking would add to a growing research field.

Ohanyan's current work, beyond a thoughtful collection of intellectually rich essays, also provides a striking (and needed) counterpoint to a narrative of globalization that, while tested in the past, still holds sway today. *Russia Abroad* provides an interesting context to assess state fragility and regional fracture relative to Russia's current machinations in its near-abroad.

But the ability to take the book's theory of regional fracture and "mean-test" it globally is critical to understanding how states are, and are not, incorporated into an assumed global order. Further, it is critical to diagnose the seams and fractures in internal governance and identify those trends or vulnerabilities that may force them to widen. Finally, knowing how powerful interlocutors can pluck these fissures like harp strings, playing chaotic tunes of state collapse, will become a central part of building state and international resiliency toward illiberal agents—something likely to define the twenty-first century.

Lieutenant Colonel Andrew Forney, USA

The Russian Understanding of War: Blurring the Lines between War and Peace by Oscar Jonsson. Georgetown University Press, 2019, 260 pp.

This doctoral dissertation turned paperback written by Oscar Jonsson is unlike most texts in the literature of this field. Dr. Jonsson holds a doctorate from King's College London's Department of War Studies and is the director of the Stockholm Free World Forum—a foreign and security policy think tank based in Sweden.

While many geopolitical works superimpose (albeit often subconsciously) the assumptions of the analyst upon that which is being analyzed (mirror imaging), *The Russian Understanding of War* seeks to pierce Moscow's strategic calculus and the "nuances of the Russian language" to answer the question, "Has the Russian understanding of the nature of war changed, and if so, how?" (ix, 4).

Jonsson frames the problem in the introduction by ensuring the audience understands the distinction between Clausewitz's "character of war" (something that perpetually evolves with technology) and the "nature of war" (something generally regarded as immutable). With the lexicon established in support of the thesis question, the author then divides his treatise into four main sections.

Section 1 ("The Soviet Understanding of War") examines the view of the collective USSR as the intellectual foundation for the Russian Federation's initial cadre of political and military leadership—with particular emphasis on the uniformity of Soviet political and military thought as an extension of Marxism-Leninism, Hegelian dialectics, and the Communist Party.

Like Clausewitz, Lenin regarded violence and armed conflict as requisites for war. However, Lenin's understanding of "politics by other means" differed on the basis that the Soviets believed war to be a paradoxical evil that could only be eliminated by establishing the dictatorship of the proletariat worldwide. Section 2 ("The Russian Understanding of War after the Dissolution of the Soviet Union") subsequently outlines how the Russian Federation's views regarding the nature of war evolved.

It stresses the gradual yet notable departure from the traditional understanding of Clausewitz as incorporated by Lenin, Stalin, and others into Communism as the official worldview of the party and the state. Finally, section 3 ("Information Warfare") and section 4 ("Color Revolutions") leverage the philosophical foundation of the first two sections to examine Russia's understanding of war relative to what it perceives as two of its greatest external/internal security threats. Ultimately, "Russian threat perception is the backdrop to Russian offensive action" (121).

This book is a remarkable and timely work of scholastic achievement with key insights for a geopolitical period of great power competition. Jonsson concludes that, as the title suggests, the Russian strategic calculus blurs the lines between war and peace. He articulately and definitively demonstrates that the principal political and military elites of Russia today believe that either the nature of war has completely changed to include "nonviolent" actions or that the fundamental definition of "violence" must be expanded to include the nontangible and nonlethal.

In either case, the net effect remains that Moscow is corporately shifting its focus toward the political goals of war rather than focusing solely on its means ("armed violence"). Moreover, Jonsson adeptly balances what the Russian inner circle believes and what it states publicly, noting that formally acknowledging its perceived change in war's nature would go against concepts that inform both international law and Russian federal law "On Defense." (Both rely on "armed violence" as the defining element of war, and organically declaring a change in war's nature would be tantamount to unilaterally declaring a worldwide state of war.)

The thesis question and its answer are supported not through an examination of Western experts writing about Russia (i.e., from an outsider's perspective) but through an exhaustive examination of documents and speeches produced by Russian politicians, strategists, tacticians, and oligarchs. Thus, Jonsson effectively uses primary source materials to generate insights about the Russian understanding of war while simultaneously minimizing the risk for analytical bias by allowing the Kremlin et al., to speak for themselves.

Ultimately, this book is a must for anyone seeking to navigate the strategic competition environment or those attempting to understand why Russia behaves in the manner it does. It may be tempting to examine Russia through several centuries of Czarist and Communist history.

But it is paramount for military strategists and analysts to remember that the Russian Federation is less than 30 years old and, particularly since the ascendance of Vladimir Putin, still finding its identity in the post–Cold War era. The author focuses on the findings of his research rather than the tangible implications for US or North Atlantic Treaty Organization (NATO) policy makers. This is perhaps the only area where the book could be improved, while in fairness such a weight of effort is common practice for a dissertation contributing to the body of knowledge in support of field practitioners.

Woven throughout this book is a singularly profound sentiment that must be understood by those in the US national security apparatus. Specifically, the following fallacious assumption must be purged from US/NATO policy development: "Western states believe it is up to them to choose whether they enter a war with Russia or not" (157).

Simply put, the Russian government is actively engaged in what it considers a "war" against the West, albeit one fought via nonmilitary means. As such, the West must change the way it thinks about deterrence, competition, and conflict when engaging Moscow and when seeking to cooperate with nations in Russia's near abroad. In other words, "when Western states are taking actions that they perceive as being short of war—sanctions, democracy promotion, and information operations—but that are understood by Russia as amounting to war, there is a risk of unconscious and/or unintentional escalation" (2).

Regardless of whether one accepts that the nature of war has changed, the semantic aspects of that philosophical and academic debate must not overshadow the real and potentially dire consequences of ignoring how Russia thinks and conducts operations. As articulated by Sun Tzu, those seeking to overcome must first "know thy enemy."

Captain Jayson M. Warren, USAF

Breaching the Summit: Leadership Lessons from the U.S. Military's Best by Kenneth O. Preston, Micheal P. Barrett, Rick D. West, James A. Roy, Denise M. Jelinski-Hall, and Charles W. "Skip" Bowen. Casemate, 2020, 278 pp.

Only 1 percent of the enlisted force in the US military can make E-9. Reaching E-9 in one of the six branches of the uniformed military services is an imposing task. *Breaching the Summit: Leadership Lessons from the US Military's Best* is a book about how six enlisted members reached the summit and what they gained from that experience. Any person who has served in the military remembers the E-9s with whom they served and the authority they exercised.

The book includes the military careers of former Sergeant Major of the Army Kenneth Preston; Sergeant Major of the Marine Corps Michael Barrett; Master Chief Petty Officer of the Navy Rick West; Chief Master Sergeant of the Air Force James Roy; Chief Master Sergeant Denise Jelinski-Hall, the senior enlisted advisor to the National Guard Bureau; and Master Chief Petty Officer of the Coast Guard Charles "Skip" Bowen. All served within the past 10 years, and their lessons learned are pertinent to the challenges currently facing the military.

Each writer is a European-American, which may reflect the challenges people of color face in reaching the most senior ranks. One of the six writers is a female, Chief Master Sergeant Jelinski-Hall. One of her valuable insights is about her success in "a man's world." Jelinski-Hall is also a member of the reserve components, another strength of the book. One of the 9/11 lessons is the importance of the reserve components and the unique challenges citizen warriors face. In the book's forward, we are told the book was designed for junior service members, senior enlisted leaders, officers, family members, and anyone who wants to know more about the military (x).

Breaching the Summit provides a biographical sketch of each contributor, along with an overview of their life focused on their military career. The authors also addressed issues such as values, character, learning from failure, and the importance of taking care of people. They also discussed leadership, what good leaders look like, and the importance of mentoring. Barrett wrote this about mentoring: "Is there such a thing as a 'self-made' person? If there is, I haven't met them yet. In my case, too many to count had a hand in getting me where I am today" (53).

Readers discover each contributor was keenly aware of the importance of their example to others. Similarly, they talked about the importance of leading from the front in sections with headings such as "Growing Leaders," "Embrace Challenges and Take Risks," and "Lead Boldly." Every military member and their organization could benefit from their views on leadership. One of the things they advise again and again is not to be afraid of failure as a person or as a leader but rather to embrace failure and learn from it (193).

Each author examined the challenges of transitioning to civilian life after a three-decade military career. The authors advised readers to begin thinking about the transition process now. Many veterans have found the health care and disability services provided by the US Department of Veterans Affairs to be uneven. Only Jelinski-Hall addressed this concern.

Understandably, the book's primary focus was on the tactical and operational aspects of the military rather than the strategic domain. In one case, Barrett wrote that when the nation needs something to be done, "or they aren't exactly sure what needs to be done, they send in the Marines. They know the Marines always figure it out and carry the day" (54).

Barrett's fervor and mission focus are extremely admirable as is the ability of the Marine Corps to get things done. But from a strategic perspective, we should carefully weigh which troops we need in a theater before we send them in. That way, we can tailor the force accordingly and ensure we are sending the skill sets needed in complex, asymmetrical battlespaces where there might be civilians and unforeseen contingencies.

The writers' faith stance is a fascinating feature of the book. Each person alluded to the importance of their faith and how it sustained and guided them. Their faith also provided the foundation for the values they embraced. We live in a society that tends to avoid discussing one's personal faith. This was not the case in *Breaching the Summit*. The leaders did not attempt to evangelize in their reading but shared how their faith enabled and empowered them.

One of the valuable tools the book provided readers was a treasure chest full of inspiring quotes. A sampling of those quotes included these:

- Albert Einstein: "Try not to become a person of success, but rather try to become a person of value" (12).
- Ralph Nader: "The function of leadership is to produce more leaders not more followers" (23).
- Ronald Reagan: "Some people spend an entire lifetime wondering if they've made a difference. The Marines don't have that problem" (53).
- Theodore Roosevelt: "The only man who never makes a mistake is the man who never does anything" (195).
- Abraham Lincoln: "Most people are as happy as they make up their minds to be" (197).

The book is a welcome addition. It would be an invaluable read for anyone engaged in professional development. I wish I had the book when I started my career as an enlisted soldier. It tells us how servant leaders reached the pinnacle of the military profession. A major strength of the US military is its noncommissioned officer corps, and that success is on full-view in *Breaching the Summit*.

Colonel Larry O. Toney, USA, Retired

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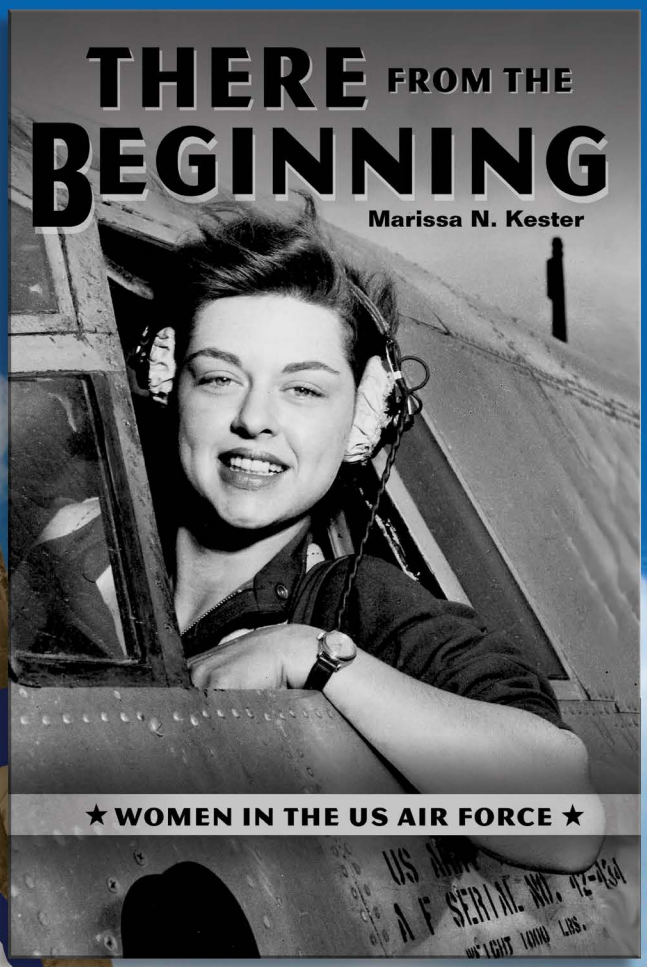

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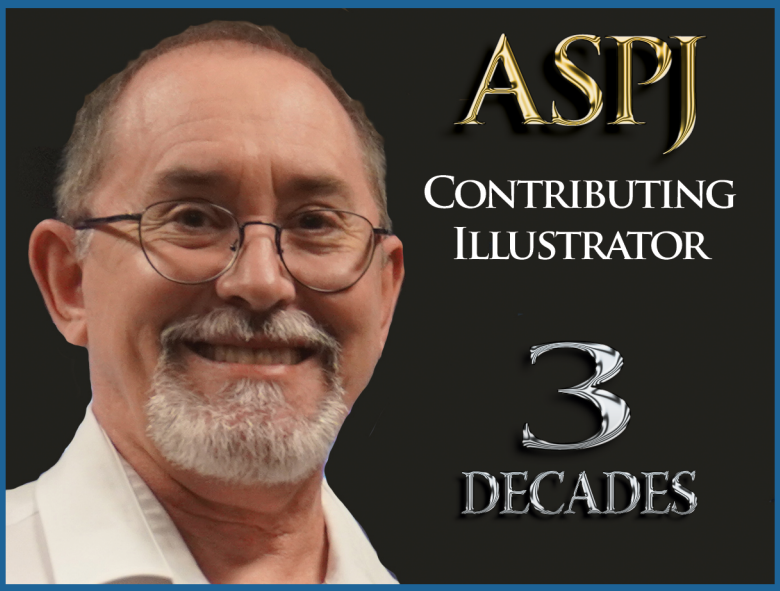

Daniel Armstrong

This issue of *Air & Space Power Journal* is dedicated to Mr. Daniel Armstrong who retired this fall after serving for 30 years as the lead and often only illustrator for Air University Press. As the lead illustrator for *ASPJ* for more than 10 years, Mr. Armstrong provided original artwork and designs for the journal. The journal has benefited greatly from Mr. Armstrong's meticulous, exacting, and award-winning work. His essential contributions to *ASPJ* will be sorely missed, and we wish him the best in his well-deserved retirement.