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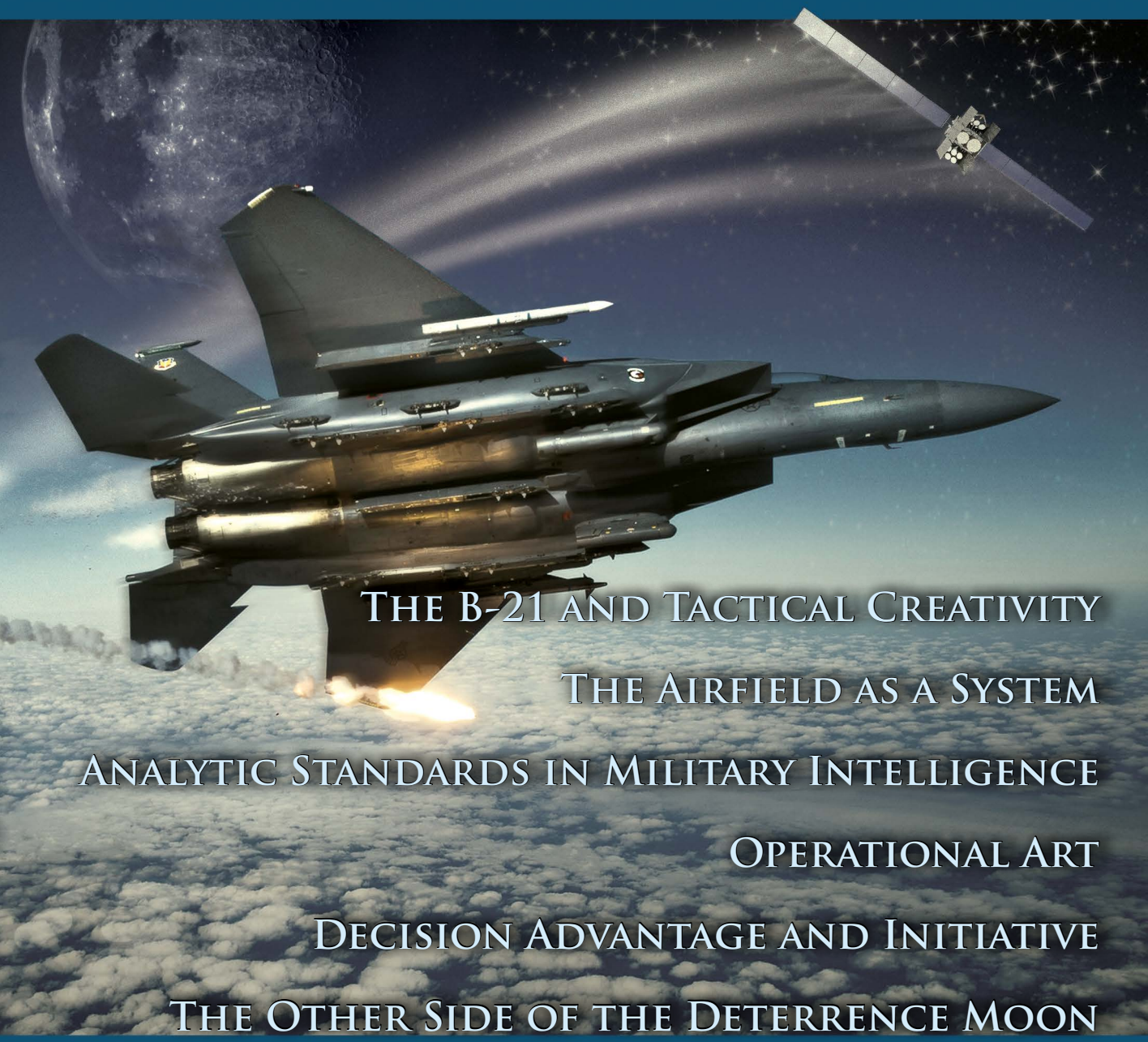

The B-21 and Tactical Creativity

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Decision Advantage and Initiative

The Other Side of the Deterrence Moon

Vol. 3, No. 1 - Spring 2024

DEPARTMENT OF THE AIR FORCE

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FROM THE EDITOR

Dear Reader,

As conflict between Israel and Iran threatens to expand, and Russia continues its war of attrition against Ukraine, air operations are persistently at the forefront of national security discourse. Military planners and strategists are absorbing real-world lessons regarding applications of and advances in contemporary air operations that have profound implications for future battles and wars in which the United States will undoubtedly engage. Our Spring 2024 issue of *Air & Space Operations Review* explores some key aspects of air operations, planning, and strategy.

The first forum, **Air Operations**, opens with an analysis of the B-21 Raider. Retired Brigadier General Paula Thornhill, USAF, and Shane Praiswater argue that in the move to pulsed operations, a rift has emerged between standoff and stand-in tactical philosophies in the combat air forces. The Raider has the capabilities to bridge this divide and help transcend long-standing parochial proclivities that have stalled the creative application of airpower. In the second article in the forum, Mark Callan proposes that airfields are centers of gravity in their own right. Accordingly, the Air Force needs to reorganize its airfields into maneuverable rhizomatic teams, mitigating the shortfalls posed by the traditional root-tree organization of service airfields.

The forum concludes with an examination of analytic standards in military intelligence. Jack Duffield finds that existing US and UK analytic standards' focus on rigor, while appropriate for the production of strategic intelligence, is less effective in producing timely, relevant analysis at the tactical and operational levels of war. The US Air Force's implementation of analytic standards provides an example of how to more effectively apply such standards at these levels.

The second forum, **Planning and Strategy**, leads with a discussion about operational art. John Corrado explores the history of operational art over the centuries and assesses its importance in contemporary military planning and strategy, against state and nonstate actors alike. In the second article in the forum, Brian Price defines decision advantage and the concept of initiative against the backdrop of John Boyd's observe, orient, decide, act (OODA) loop, finding that decision advantage is necessary to operationalizing initiative. In the final article of the forum and the issue, Tim Georgetti argues for the notion of deterrence from space, reframing space capabilities—such as orbital-class rocket resupply and space-based solar power—as both powerful deterrents and liabilities in need of defense.

As always, we welcome thoughtful, well-researched responses to our articles, with a potential for publication in a future issue. Thank you for your continued support of the journal.

~The Editor

The B-21 and Tactical Creativity

Shane Praiswater
Paula G. Thornhill

Combat air forces tacticians and operational planners have yet to understand the B-21 Raider's potential capability. Leadership's vision is clear, but service-level parochial interests, insular platform cultures, and competition for resources are creating unhealthy tensions within the combat air forces, Department of the Air Force, and across the Joint force. Such tensions could severely hamper tactical creativity, operational planning, and strategic competition, ultimately undermining the US Air Force's effectiveness against a peer adversary. Amid the move toward pulsed operations, a rift has emerged between standoff and stand-in tactical philosophies. Yet the B-21 Raider's family of systems at a minimum operates in both areas, likely demanding a reconsideration of these concepts. Such a reconsideration can also help the Air Force transcend stealth/nonstealth and fighter/bomber debates to embrace new levels of tactical creativity.

Secretary of the Air Force Frank Kendall III established operational imperatives for the US Air Force in recognition that adversaries have "capabilities designed to defeat the United States' ability to project power."[1] These imperatives state that diverse capabilities are necessary, but translating Secretary Kendall's vision to the tactical level may prove difficult. Amid the combat air forces' (CAF) move toward pulsed operations, a rift has emerged between standoff and stand-in tactical philosophies.[2] Additionally, as the B-21 Raider's family of systems has capabilities in both areas, the service will soon need to reconsider these concepts.

As a unique, sixth-generation platform, the B-21 can help the Air Force transcend the stealth-versus-nonstealth and fighter-versus-bomber debates and embrace new levels of tactical creativity. Cultural shifts are necessary for the CAF to accept the idea of a bomber leading—and providing persistence—during pulsed operations. The B-21 and its family of systems would not just be a lead striker; it would be a platform enabling pulsed operations or even utilizing pulsed strike packages as dynamic employment options.

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Dr. Paula Thornhill, Brigadier General, USAF, Retired, is an associate professor at Johns Hopkins University's School of Advanced International Studies and an adjunct senior political scientist at the RAND Corporation. She is the author of Demystifying the American Military: Institutions, Evolutions, and Challenges since 1789 *(Naval Institute Press, 2019).*

1. Frank Kendall III, "Department of the Air Force Operational Imperatives," infographic, US Air Force (USAF), March 31, 2022, https://www.af.mil/.

2. "Air Force Future Operating Concept Executive Summary" (Washington, DC: USAF, March 6, 2023), https://www.af.mil/.

This article is not about one aircraft being more important than another; rather, it argues a shift in perspective is necessary due to the cultural problems surrounding aircraft specialization, which can lead to a narrowed focus regarding other platforms. Because of the smaller bomber community, without a cultural shift that recalibrates CAF operations in great power competition, the service might not employ the B-21 to a level sufficient to achieve Secretary Kendall's vision. Even worse, absent a proper and persistent demand signal from the CAF, the B-21, like any burgeoning acquisition program, might be vulnerable to budget cuts and risk becoming a redux of the reduced B-2 Spirit fleet.[3]

Combat air forces tacticians and operational planners tend to reduce the operational imperatives and the concept of pulsed operations to embrace standoff tactics while largely ignoring stand-in advantages, thus leaving holes in operational plans. The B-21 Raider family of systems addresses these challenges by unlocking the Joint force with stand-in capabilities and addressing current Indo-Pacific region shortfalls. Through a reconsideration of the standoff and stand-in concepts, the CAF can move past current debates and misconceptions to materialize unprecedented levels of tactical creativity and operational planning.

The authors draw from considerable experience in the Pentagon, with Congress, and in all levels of war. The B-21's initial cadre have returned to the combat air forces after staff tours that revealed the propensity for budget advocacy to split along platform lines. While Secretary Kendall's initiatives are encouraging, and despite the fascinating and potentially revolutionary aspects of the B-21, CAF planners and tacticians are not prepared to think differently, given immediate challenges and parochial attitudes. This article thus analyzes the key issues afflicting combat air forces—most notably, the ongoing lack of tactical creativity and an adherence to rigid operational maneuver—and offers recommendations to mitigate them.

Standoff versus Stand-in Debate

Secretary Kendall's operational imperatives emphasize that resilient and redundant operations are necessary to compete with peer adversaries.[4] In light of aggressive statements from China and the enduring risk of escalation in Ukraine, the US Air Force faces a significant challenge in preparing to fight now while simultaneously planning for future operations.[5] By focusing on the most immediate threats at the expense of future considerations, combat air forces resist tactical creativity—the ability to consider novel solutions based on emerging capabilities potentially dissimilar to established techniques and procedures.

3. Sebastien Roblin, "The U.S. Air Force's Biggest Mistake: Only 20 B-2 Stealth Bombers in the Force," *National Interest*, February 23, 2024, https://nationalinterest.org/.

4. Charles Pope, "Kendall Details 'Seven Operational Imperatives' & How They Forge the Future Force," USAF, March 3, 2022, https://www.af.mil/.

5. Dave Lawler, "Xi Vows China and Taiwan Will 'Surely Be Reunified' in New Year's Speech," Axios, January 1, 2024, https://www.axios.com/.

The most recent effort focused on near-term conflicts revolves around the concept of pulsed operations. The Air Force Future Operating Concept argues winning "six critical and concurrent fights" requires " 'pulsed airpower'," or "concentrating of airpower in time and space to create windows of opportunity for the rest of the force."[6] Pulsed operations are a significant shift within CAF culture. Previously, establishing a relative level of enduring air superiority was an assumed objective.[7] The shift is, of course, a sober reaction to realities: US adversaries, having observed the Air Force's dominance and ability to unlock Joint force capabilities, have invested incredible resources into making air supremacy impossible and even temporary air superiority as difficult as possible for the United States and its Allies and partners near hostile territories.[8]

Pulsed operations might be wise under certain constraints, but the fact remains that embracing such a mindset de facto cedes control over a given area to the enemy for the majority of a conflict. Pulsing is a concept driven primarily by geography, not threats. Given more forgiving distances, the CAF might entertain more traditional methods to continually contest airspace control: the lack of a persistence-capable platform denies comprehensive takedowns of adversary defenses that require constant pressure to suppress. Furthermore, an inclination to employ standoff tactics in the execution of pulsed operations risks treating potential conflicts as anti-access/area denial (A2/AD) problems in which more sustainable tactics are not possible.

Evidence from wargames and acquisitions suggests pulsed operations are evolving into standoff-dependent tactics. Most recently, an unclassified wargame found standoff weapons were "war-winning" weapons, although the United States won—at a great cost—only a "Pyrrhic victory" in 2026.[9] The same wargame also found that China would continue to evolve and target bombers employing standoff weapons, if not the weapons themselves.[10]

Regarding acquisitions, weapons priorities in the president's Fiscal Year 2024 budget, approximately $15.1 billion worth, were all standoff munitions—Standard Missile (SM)-6, Air Intercept Missile (AIM)-120D Advanced Medium-Range Air-to-Air Missile (AMRAAM), Long-Range Anti-Ship Missile (LRASM), and Joint Air-to-Surface Standoff Missile (JASSM)-ER.[11] Furthermore, to counter the decades-long effort to "install

6. "Future Operating Concept."

7. Elliot M. Bucki, "Flexible, Smart, and Lethal," *Air & Space Power Journal* 30, no. 2 (Summer 2016).

8. Jeff Hagen et al., *The Foundations of Operational Resilience—Assessing the Ability to Operate in an Anti-Access/Area Denial (A2/AD) Environment: The Analytical Framework, Lexicon, and Characteristics of the Operational Resilience Analysis Model (ORAM)* (Santa Monica, CA: RAND Corporation, July 7, 2016), https://doi.org/.

9. David Axe, "3,600 American Cruise Missiles versus the Chinese Fleet: How One U.S. Munition Could Decide Taiwan's Fate," *Forbes*, January 9, 2023, https://www.forbes.com/; and Mark F. Cancian and Eric Heginbotham, "The First Battle of the Next War: Wargaming a Chinese Invasion of Taiwan," CSIS: Center for Strategic & International Studies, January 9, 2023, 4, https://www.csis.org/.

10. Cancian and Heginbotham, 140.

11. *Program Acquisition Cost by Weapon System: US Department of Defense Fiscal Year 2024 Budget Request* (Washington, DC: Office of the Under Secretary of Defense [Comptroller]/Chief Financial Officer, March 2023), iii, https://comptroller.defense.gov/.

thickets of surface-to-air missiles" posing a "wicked problem for U.S. forces," the Pentagon is ramping up standoff acquisitions.[12]

The change in acquisition strategies reflects threats in which the "defense is inherently the stronger form of air warfare, and new and emerging technologies and tactics are only strengthening the defender's advantage."[13] Whether or not this argument is valid, the combination of unclassified wargames and acquisitions reflects how planners and tacticians prioritize standoff tactics during pulsed operations. They are not necessarily proclaiming a standoff dependency; they are just planning based on the understanding of the threat and weapons provided during ongoing acquisition debates.

This planning methodology creates artificial tactical limits and critical dependencies. As Israel and Russia are learning today, standoff weapons cannot achieve full military objectives, which then limits national leaders' decision space and cedes the adversary significant advantages.[14] The further back the combat air forces launch weapons, the more complicated the kill chain required. Forces must locate, destroy, and verify targets that might be mobile or fleetingly observable while defeating systems finely tuned toward the destruction of standoff munitions and platforms. Correlating pulsed operations with standoff tactics makes those tactical problems inherently more complicated by removing pressure and playing to the adversary's strengths; namely, that by 2030, "stronger Chinese conventional capabilities and a survivable nuclear deterrent" complicate potential US theories of victory.[15]

Furthermore, the move toward pulsed operations might be feeding a dangerous perspective within the CAF, where it is believed a large-scale peer conflict will likely be short. To be clear, the "wish-casting" associated with a short war is hardly the predominant view in the Pentagon or literature, but behind the scenes, this viewpoint is surprisingly common within the CAF. This belief contravenes most expert opinions and belies an ignorance of the "fragmented authoritarianism" within China, which persists under President Xi Jinping. Considering the consensus necessary within China to make

12. Christopher Woody, "The US Air Force Is Training to Take Down Chinese Warships, but China's Military Has Built a 'Wicked' Problem for It to Overcome," *Business Insider*, November 13, 2023, https://www.businessinsider.com/; and Inder Singh Bisht, "Pentagon Wants to Ramp-Up Ship-Killing Missile Procurement," Defense Post, April 7, 2023, https://www.thedefensepost.com/.

13. Maximillian Bremer and Kelly Grieco, "Assumption Testing: Airpower Is Inherently Offensive, Assumption #5," Policy Paper, Stimson, January 25, 2023), https://www.stimson.org/.

14. Ron Tira, *The Limitations of Standoff Firepower-Based Operations: On Standoff Warfare, Maneuver, and Decision* (Tel Aviv: Institute for National Security Studies, 2007), https://www.jstor.org/; Gregory Weaver, "The Role of Nuclear Weapons in a Taiwan Crisis," Atlantic Council (blog), November 22, 2023, https://www.atlanticcouncil.org/; and Alex Vershinin, "The Challenge of Dis-integrating A2/AD Zone: How Emerging Technologies Are Shifting the Balance Back to the Defense," *Joint Force Quarterly* 97 (2nd Quarter, 2020), https://ndupress.ndu.edu/.

15. Jacob L. Heim, Zachary Burdette, and Nathan Beauchamp-Mustafaga, *U.S. Military Theories of Victory for a War with the People's Republic of China* (Santa Monica, CA: RAND Corporation, February 21, 2024), 5, https://doi.org/.

critical state decisions, it is highly unlikely a war would be started on such a whim that initial failure would lower national resolve.[16]

Completing long-range kill chains to meet pulsed operation objectives in a short series of battles seems feasible, but doing so in a long, potentially escalating war will likely prove much more difficult. If operators base their training on winning a short-term fight, painful—or even catastrophic—lessons might ensue.

Pulsed operations are a rational response to peer threats. Yet the implicit correlation of this concept with standoff tactics in a short conflict reduces the capacity for tactical creativity and fails to meet the higher-level guidance provided by Secretary Kendall's operational imperatives or the tough operational problems any ensuing service leader would face. Even worse, the defensive advantage—nothing new in modern warfare—has not made peer adversary defenses invulnerable, but it has made, in most cases, the term standoff inaccurate for many threats. The CAF will likely be employing weapons within threat rings, and the weapons themselves are possible to target.[17] In other words, standoff implies a level of safety or lower risk, combined with mission success, that is misleading. Moreover, the logic of perpetual standoff is unsustainable; at some point, a platform or weapon must enter a threat area.

Meanwhile, while the CAF uses the term stand-in for penetrating assets, the truth is more nuanced. The B-21's capabilities allow it to be much closer to targets but still outside threat capabilities. The shorter distance makes weapons considerably more survivable and the process of striking fleeting or mobile targets more realistic. The reduced distances necessary for future weapons allow for acquisitional strategies favoring smaller, faster systems with advanced seekers that provide the mass and persistence lacking with large, exquisite—and expensive—hypersonics.

A stand-in capability, including a platform such as the B-21, could enable the long-range kill chain standoff tactics currently favored by the CAF or act as an organic firing solution—thus not requiring offboard support—for critical threats in GPS and space-denied environments.[18] The organic targeting aspect is important, as the combination of limited penetrative assets and rapidly improving adversary threats is pushing the CAF into long-range kill chain tactics that are inherently inorganic.

These kill chains require players both in and outside of the Department of Defense to strike highly contested targets. The Joint force has made laudable efforts to acquire the resources necessary to implement long-range kill chain tactics. Yet an inescapable issue remains: each link is a vulnerability, and the more links required for mission success, the

16. Andrew Mertha, " 'Fragmented Authoritarianism 2.0': Political Pluralization in the Chinese Policy Process," *China Quarterly* 200 (December 2009), https://doi.org/.

17. Susie Blann, "Russia Fires 30 Cruise Missiles at Ukrainian Targets; Ukraine Says 29 Were Shot Down," AP, May 19, 2023, https://apnews.com/.

18. Eric Heginbotham et al., *The U.S.-China Military Scorecard: Forces, Geography, and the Evolving Balance of Power, 1996–2017* (Santa Monica, CA: RAND Corporation, September 14, 2015), 241, https://www.rand.org/.

more opportunities an adversary has to disrupt or delay the targeting process.[19] The CAF can compensate for those vulnerabilities by creating contingency solutions or lobbying for redundancies, but the latter are not free and require acquisition resources in a contentious spending environment.

The B-21 and its stand-in capabilities can fill operational shortfalls and address the tenuous assumptions on which pulsed operations with standoff tactics depend. As adversary systems improve, the B-21 and its family of systems can enable legacy standoff platforms by eliminating the most critical threats to fifth-generation platforms and weapons. Most importantly, the B-21 can help address significant hurdles facing the CAF in theaters requiring pulsed operations. Given the standoff, fighter-centric approaches currently preferred or required, planners must reckon with four specific challenges.

Limited Fuel

The first assumption Indo-Pacific-region plans rely on is that air and ground refueling will be available. Given China's A2/AD capabilities and the so-called tyranny of distance, the idea that refueling tankers will be able to support fighters even in pulsed operations is tenuous at best. Tankers will require levels of escort that detract from difficult targeting operations and depend on accessible basing, not to mention willing Allies and partners and vulnerable supply chains.[20]

Vulnerable Bases

If adversaries choose to employ the full weight of their ballistic arsenal against US regional bases, those operational headquarters are unlikely to survive. Dispersed ops are a potential answer, but those tactics have limitations and are still vulnerable to follow-on strikes.[21] It is telling that wargames in the last decade have focused on whether the United States will target mainland China in a conflict over Taiwan.[22]

Notwithstanding this welcome dose of political realism into planning assumptions, a decision not to target China seems to be driven by the recognition that if China uses its substantial missile arsenals to attack US bases in the Indo-Pacific—if not the US mainland—the Air Force will struggle mightily to counter an invasion of Taiwan. The combat air forces are not declining to target the Chinese mainland due to potential

19. Heather Penney, "Scale, Scope, Speed & Survivability: Winning the Kill Chain Competition," *Mitchell Institute Policy Paper* 40 (May 2023), https://mitchellaerospacepower.org/.

20. Andrew Tilghman, *Guam: Defense Infrastructure and Readiness*, R47643 (Washington, DC: Congressional Research Service, August 3, 2023), https://crsreports.congress.gov/.

21. Patrick Mills et al., *Building Agile Combat Support Competencies to Enable Evolving Adaptive Basing Concepts* (Santa Monica, CA: RAND Corporation, April 16, 2020), https://doi.org/.

22. John Speed Meyers, *Mainland Strikes and U.S. Military Strategy towards China: Historical Cases, Interviews, and a Scenario-Based Survey of American National Security Elites* (Santa Monica, CA: RAND Corporation, December 20, 2019), https://doi.org/.

political realities. Instead, planners hope China will reciprocate by declining to target Guam, Japan, or other nations due to Xi's concerns "about the PLA's ability to fight and win wars" and the risk of undermining Chinese Communist Party control.[23]

Especially since an invasion of Taiwan will already be occurring under devastating political and economic conditions, it seems beyond fanciful to hope China will cede its greatest advantage in what would already be a war with the highest stakes imaginable.[24] Even the assumption that there is a meaningful distinction between the First and Second Island Chains might be problematic: it is unlikely China would be content to eliminate only Okinawa if the United States could continue meaningful operations from Guam.[25] Given the fallout from an invasion of Taiwan, it is logical to assume a Chinese Communist Party leader who orders such a drastic action would face regime-threatening implications upon failure.[26]

Assuming an inherently limited conflict disfavoring the enemy—to enable a preferred set of tactics—is dangerous. Agile combat employment might mitigate risks to short-range aircraft, but unless such efforts are flawless, fighters—and tankers, to an extent—cannot reach the fight or seriously affect it without convenient basing. The 2022 *National Defense Strategy* explicitly states that regional base protection, specifically Guam, is a priority, but the Air Force has largely assumed that the missile defense emphasis and expeditionary constructs will somehow ensure base viability.[27]

Unpredictable Precision Navigational Timing

Despite years of acknowledgment that GPS may not be available or effective before or during a war, the Joint force remains critically reliant on GPS to employ weapons, especially against standoff targets. JASSM, for example, requires GPS to reach a final point where an infrared seeker combined with anti-GPS jamming is effective.[28] This assumption is dangerous because US adversaries continue to invest heavily in GPS-jamming technology, not to mention the ability to shoot down the satellites themselves.[29]

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23. Mark Cozad et al., *Gaining Victory in Systems Warfare: China's Perspective on the U.S.-China Military Balance* (Santa Monica, CA: RAND Corporation, 2023), 113, vi, https://doi.org/.

24. "Invading Taiwan Would Be a Logistical Minefield for China," *Economist*, November 6, 2023, https://www.economist.com/.

25. Derek Grossman, "America Is Betting Big on the Second Island Chain," *RAND Blog*, September 8, 2020, https://www.rand.org/.

26. Andrew Mertha, " 'Stressing Out': Cadre Calibration and Affective Proximity to the CCP in Reform-era China," *China Quarterly* 229 (March 2017), https://doi.org/.

27. Anthony H. Cordesman, "The New U.S. National Defense Strategy for 2022," CSIS, October 28, 2022, https://www.csis.org/.

28. John Keller, "Lockheed Martin to Test and Integrate Extreme-Range Air-to-Ground Missile with GPS and Infrared Guidance," *Military + Aerospace Electronics*, June 5, 2023, https://www.militaryaerospace.com/.

29. Sandra Erwin, "U.S. Military Doubles Down on GPS despite Vulnerabilities," *SpaceNews*, August 9, 2021, https://spacenews.com/.

Contested Space Domain

The threat to GPS satellites is clearly not restricted to navigation.[30] The previously mentioned tactical problem of targeting would be virtually impossible without the space layer and tactics that allow for target identification and actual weapon targeting—thus the intricacies and inherent vulnerabilities of long-range kill chains. Difficult enough as a standoff tactic, these kill chains, without the space layer, which includes much more than GPS, might prove impractical, at best.[31] The electromagnetic spectrum is also necessary to complete kill chains, even with a pristine space capability.[32] The recent concern over the possible Russian deployment of nuclear weapons in space highlights this vulnerability.[33]

Given the reality of these four challenges and the nuances of standoff versus stand-in, embracing the B-21 and discovering how to unlock its tactical creativity can unleash a devasting physical and psychological weapon. The B-21 does not solve every tactical problem, but it counters multiple airpower weaknesses and the investments adversaries have made to defeat the United States.

Unique Capabilities of the B-21

The US Air Force will soon possess an unparalleled and novel asset capable of creating effects that manipulate the enemy and shape its reactions before or during pulsed operations. Despite its appearance, the B-21 is not, as some derisively refer to it, a B-2.1. While both platforms are highly survivable in contested environments, the B-21 earns its sixth-generation moniker by representing an evolutionary leap in stealth technology.[34] As Secretary of Defense Lloyd J. Austin III stated, "Fifty years of advances in low-observable technology have gone into this aircraft . . . Even the most sophisticated air-defense systems will struggle to detect a B-21 in the sky."[35] The CAF must wisely integrate the B-21 into tactical and operational plans to engender the best possible combat outcomes.

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30. Kevin L. Pollpeter, Michael S. Chase, and Eric Heginbotham, *The Creation of the PLA Strategic Support Force and Its Implications for Chinese Military Space Operations* (Santa Monica, CA: RAND Corporation, November 10, 2017), 9, https://doi.org/.

31. Courtney Albon, "Space Force Seeking $1.2B for 'Long Range Kill Chains' Target Tracking," Defense News, March 20, 2023, https://www.defensenews.com/.

32. Raj Agrawal and Christopher Fernengel, "The Kill Chain in Space: Developing a Warfighting Mindset," *War on the Rocks*, October 24, 2019, https://warontherocks.com/.

33. David Sanger and Julian Barnes, "US Fears Russia Might Put a Nuclear Weapon in Space," *New York Times*, February 17, 2024.

34. Mark Gunzinger, *Understanding the B-21 Raider: America's Deterrence Bomber* (Arlington, VA: Mitchell Institute for Aerospace Studies, March 2023), https://mitchellaerospacepower.org/.

35. C. Todd Lopez, "World Gets First Look at B-21 Raider," Department of Defense (DoD) News, December 3, 2022, https://www.defense.gov/.

Furthermore, the B-21 is far more flexible, adaptable, and dynamic than the B-2.[36] Organic firing capabilities allow the B-21 to operate, if necessary, without significant preplanning, and switching targets or missions airborne is no more difficult than what the CAF became accustomed to in decades of close air support and dynamic targeting. Therefore, the B-21 can enable the long-range kill chain standoff tactics preferred by the CAF or be an organic firing solution for critical targets in GPS- and space-denied environments.[37]

The B-21's organic capabilities will not make long-range kill chain tactics obsolete; indeed, the bomber's sixth-generation characteristics, combined with its unique payload, offer the ultimate defense against adversary defensive efforts to deplete these kill chains. A fully resourced B-21 fleet will be able to operate in areas previously considered A2/AD protected. Stopping the Raider would significantly drain adversary resources and require an incredible degree of focus in the chaos of battle, both factors that enable current and future long-range kill chain efforts.

Even if an adversary did discover a way to counter the platform, the Raider's most important feature is its modularity. Specifically designed with the space and capability to integrate emerging systems rapidly, the B-21 is not only a response to current adversary decisions but also an inherent counter to future enemy plans.[38] Even among the Joint force, the B-21's modularity and organic firing capabilities make it the most efficient form of adapting to a war's unknowns and adjustments while acting as a backstop for long-range kill chain effectiveness.

Additionally, just as the B-21 directly contradicts adversary decisions and capabilities in the electromagnetic spectrum, this sixth-generation jet addresses the CAF's four major challenges mentioned in the previous section. A B-21's inherent fuel efficiency and range drastically reduce the fuel bill, enabling a contiguous US strike capability and lowering the dependency on forward bases. The Raider's nuclear-hardened nature mitigates any loss of GPS because nuclear-hardened jets are inherently resilient against GPS jamming, and its full suite of sensors only strengthens its redundancy.[39] Similarly, due to its dynamic and organic firing capabilities, the B-21 is not dependent on the space layer usually necessary to execute kill chains against fleeting targets.[40]

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36. Tara Copp, "Pentagon Debuts Its New Stealth Bomber, the B-21 Raider," AP, December 3, 2022, https://apnews.com/.

37. Cameron Hunter, "The Forgotten First Iteration of the 'Chinese Space Threat' to US National Security," *Space Policy* 47 (February 2019), https://doi.org/.

38. Stefano D'Urso, "New Photo and Details about B-21 Raider Program and Progress Released," *Aviationist*, September 18, 2023, https://theaviationist.com/.

39. Inder Singh Bisht, "USAF Tests B-2 Bomber System for GPS-Denied Environments," Defense Post, July 13, 2022, https://www.thedefensepost.com/; and Greg Hadley, "What Happens If GPS Goes Dark? The Pentagon Is Working on It, Space Force General Says," *Air & Space Forces Magazine*, May 12, 2022, https://www.airandspaceforces.com/.

40. Albon, "Space Force."

Stand-in with the B-21 also addresses the issues of available weapons rails and the rising costs of hypersonics and associated upgrades.[41] The Air Force obtains the best strike efficiencies when prioritizing mass at the lowest possible costs, but depending on fighters—with their limited payloads—carrying standoff weapons results in poor costs per effect.[42] Again, with limited B-2s and aging legacy bomber fleets undergoing difficult upgrades, poor strike efficiencies have been prerequisite costs. Yet the B-21 can start a commitment toward reversing the decades-long trend away from better strike efficiencies.[43]

Unless the combat air forces embrace tactical creativity or at least understand the B-21's capabilities, however, it will be difficult to inform national leadership how the B-21 could impact the battlefield and adversary decision-making. It is one thing to threaten the full force of US conventional capabilities in a manner the enemy has been preparing for; it is quite another to employ an aircraft capable of operating efficiently at the time and place of its choosing. While hardly a silver bullet, fully realized, the B-21 could unlock Joint capabilities and make more palatable solutions possible in a peer conflict if the CAF can embrace tactical creativity through cultural changes.[44]

Beyond the Debates: Tactical Creativity

The key to translating Secretary Kendall's operational imperatives to the tactical level—or, at a deeper level, increasing national-leader decision space beyond its current tactical limits against a peer adversary—is finding a way for the combat air forces to move beyond the stealth versus non-stealth, fighter versus bomber, and stand-in versus standoff debates. Cultural adjustments are foundational to such an effort. For decades, the Air Force has integrated with varying degrees of success against varying levels of opponents. Leveraging the unique capabilities that fifth- and sixth-generation aircraft bring, however, will require stand-in bombers and their family of systems to play a dynamic and leading role to which fighter-led combat air forces are unaccustomed.[45]

The current emphasis on standoff tactics undergirding pulsed operations is at least some recognition that the Air Force has moved past the alleged successes of the first Gulf War, in which even sympathetic accounts, such as those written by former President George

41. Mikayla Easley, "Physics and Cost Are Shaping Pentagon's Hypersonics Paths," DefenseScoop, April 11, 2023, https://defensescoop.com/.

42. David Deptula and Douglas A. Birkey, "Resolving America's Defense Strategy-Resource Mismatch: The Case for Cost-Per-Effect Analysis," *Mitchell Institute Policy Paper* 23 (July 2020), https://mitchellaerospacepower.org/.

43. Mark Gunzinger, "Stand In, Standoff," *Air & Space Forces Magazine*, July 1, 2020, https://www.airandspaceforces.com/.

44. Daniel L. Haulman, "Fighter Escorts for Bombers: Defensive or Offensive Weapons," *Air Power History* 66, no. 1 (2019).

45. S. Rebecca Zimmerman et al., *Movement and Maneuver: Culture and the Competition for Influence among the U.S. Military Services* (Santa Monica, CA: RAND Corporation, February 25, 2019), https://doi.org/.

Bush, make it clear that the United States was operating against a vastly inferior opponent.[46] Yet the transition to pulsed operations supporting standoff tactics has not—at least yet—produced a version of the combat air forces radically dissimilar from the forces that swamped Saddam Hussein in different decades. Furthermore, as numerous pundits and leaders have pointed out, twenty years of close air support has not prepared the CAF for a large-scale conflict against a peer adversary.[47]

Embracing the B-21's full capabilities would not mean rejecting pulsed operations or standoff capabilities. Instead, combat air forces could start to engage the tactical creativity that a persistent stand-in capability permits, whether as an enabler for pulsed operations, a roaming threat that distracts the enemy, or—most tantalizingly—a mission-command platform that dynamically directs pulsed operations against emerging targets. In some respects, the F-35 Lightning II and F-15EX Eagle II communities have already started these conversations by examining how a fourth-generation platform can complement fifth-generation stealth.[48]

This integrated vision might seem an obvious goal, but the idea of dynamic stand-in bombers leading pulsed operations does not exist in current doctrine. This doctrinal proclivity is not inimical. Rather, it is the natural progression of thought given the Air Force's evolution toward fighters in the 1970s. Today, however, the Air Force faces more existential adversaries.[49] Parochial fights within the service are not unusual, but there is also an ongoing debate over stealth due to the "threat" that stealth platforms present to traditional, nonstealth platforms.[50]

Unfortunately, the combat air forces are starting from a disadvantageous position regarding stealth. The F-117 Nighthawk's "retirement" in 2008 left the service with a de facto niche capability in the B-2 due to its limited numbers, maintenance complications, and nuclear commitments—that is, tacticians must assume that in any peer-to-peer conflict, the B-2 might not be readily available due to nuclear alerts.[51] As a result, even with the

46. George Bush and Brent Scowcroft, *A World Transformed* (New York: Vintage Books, 1999).

47. Thomas Greenwood, Terry Heuring, and Alec Wahlman, "The 'Next Training Revolution': Readying the Joint Force for Great Power Competition and Conflict," *Joint Force Quarterly* 100, 1st Quarter (2021), https://ndupress.ndu.edu/.

48. John A. Tirpak, "Joining Up on the F-15EX," *Air & Space Forces Magazine*, November 1, 2020, https://www.airandspaceforces.com/.

49. Zimmerman et al., *Movement and Maneuver*.

50. Mike Worden, *Rise of the Fighter Generals: The Problem of Air Force Leadership 1945–1982* (Maxwell AFB, AL: Air University Press [AUP], 1998); Mike Pietrucha, "Low-Altitude Penetration and Electronic Warfare: Stuck On Denial, Part III," *War on the Rocks*, April 25, 2016, https://warontherocks.com/; Pietrucha, "Rediscovering Low Altitude: Getting Past the Air Force's Overcommitment to Stealth," *War on the Rocks*, April 7, 2016, https://warontherocks.com/; and Pietrucha, "The U.S. Air Force and Stealth: Stuck On Denial Part I," *War on the Rocks*, March 24, 2016, https://warontherocks.com/

51. "Special Report: Nuclear Posture Review - 2018," DoD, accessed January 6, 2024, https://dod.defense.gov/.

introduction of fifth-generation fighters, planners and tacticians do not appreciate the B-2's penetration capabilities and how many targets the stealth fleet can service.

Ironically, the current B-2 community has enabled tacticians' misperceptions regarding advanced stealth tactics by embracing an insular culture in line with its highly classified programs. Air Force leadership has wisely adopted a more open stance with the B-21: its initial testing has been in broad daylight, and the B-21's special access classifications could—in theory—be downgraded, at least in part.[52] Unlike the B-2, this would allow more tacticians to understand the B-21's full capabilities and present creative options to operational and strategic leaders.

Yet reducing classifications is no small task. The Air Force has struggled for decades with "keeping a high fence around a small yard" to protect innovation advantages while increasing platform crosstalk.[53] The service should consider the lessons of the F-117 and General W. L. "Bill" Creech, whose support of the stealth aircraft was contentious. Warfighters initially could not accept that the F-117 could act "as an enabler of the defense-rollback strategy as well as a means to strike deep targets of high value."[54]

Above all, the Air Force as a whole must avoid categorical statements such as "stealth is dead" or "stealth is the price of admission."[55] The latter statement has been taken out of context: it never meant that nonstealth platforms were unimportant. Additionally, while former Vice Chairman of the Joint Chiefs of Staff Paul Selva acknowledged the constant race between stealth and counterstealth, he also couched those comments with the assertation that training—and by extension, packaging and planning—were what allowed stealth to provide an "advantage over your adversary's detection and targeting systems, not dissimilar to quieting in submarines."[56]

While sixth-generation stealth assets can still reach stand-in ranges with reduced risk, they are not white knights single-handedly capable of winning a war. Moreover, the stealth of fifth-generation aircraft will struggle outside of pulsed scenarios if the CAF refuses to embrace an integrated approach. Likewise, sixth-generation stealth is only "dead" if unsupported B-21s are expected to behave as invisible platforms, not platforms utilizing a family of systems and classified capabilities to achieve persistent stand-in ranges.[57]

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52. John A. Tirpak, "12 Things We Learned from the New B-21's Taxi Tests and First Flight," *Air & Space Forces Magazine*, November 22, 2023, https://www.airandspaceforces.com/.

53. Laskai Lorand and Samm Sacks, "The Right Way to Protect America's Innovation Advantage," *Foreign Affairs*, October 23, 2018, https://www.foreignaffairs.com/.

54. James Slife, *Creech Blue: Gen Bill Creech and the Reformation of the Tactical Air Forces* (Maxwell AFB, AL: AUP, in collaboration with College of Aerospace Doctrine, Research, and Education, 2004), 59, https://www.airuniversity.af.edu/.

55. Pietrucha, "Stuck on Denial"; and Josh Wiitala, "The Price of Admission: Understanding the Value of Stealth," *War on the Rocks*, June 2, 2016, https://warontherocks.com/.

56. Adam Twardowski, "The Future of US Defense Strategy: A Conversation with General Paul J. Selva," Brookings, July 2, 2019, https://www.brookings.edu/.

57. Joe Pappalardo, "PM Interview: Air Force Gen. Mark A. Welsh III," *Popular Mechanics*, April 15, 2014, https://www.popularmechanics.com/.

A combat air force culture that embraces an integrated approach should recognize the nuances of stealth, reexamine the roles of traditional bombers versus the B-21, and recapture the ability to balance immediately necessary standoff tactics with an earnest desire for tactical creativity and stand-in capabilities. Part of this cultural change must include the Joint force, namely US Strategic Command, and the recognition that a fully capable B-21 fleet will enable conventional escalation options so influential as to replace tactical nuclear options.

This is not to imply nuclear certification of the platform should be delayed, although if it were to impede conventional capabilities, slightly delaying nuclear capabilities should be acceptable. Rather, agreements should be made now to prevent the type of Strategic Air Command conflicts that bedeviled planners in Vietnam desperate to maximize the B-52's conventional effects when the bombers were committed foremost to the nuclear Single Integrated Operational Plan.[58]

Overall, parochial fights are inevitable given restricted resources and Beltway politics, but arguably, the most significant issue facing CAF warfighters is the rifts that have seeped down to the tactical level. These rivalries are not a luxury the service can afford in a large-scale conflict against a determined peer adversary. While the comparison might be hyperbole, on its current path—embracing standoff/fighter-based tactics at the expense of a platform such as the B-21—the CAF could be replicating the disastrous mistakes plaguing past militaries as they chose precious cultural attitudes over necessary evolutions.[59]

Conclusion and Recommendations

If the B-21 program—which is still in early testing—remains on track, the Air Force has a game-changing asset coming sooner rather than later. To that end, there are three general steps leadership might consider to improve its chances in a near-term conflict.

Expedite Production and Prioritize Testing

History proves accelerating a successful program is a matter of motivation, faith, and money. The United States famously produced one B-24 per hour at Willow Run during World War II; less effort is probably necessary to embrace a breakout mindset with the B-21.[60] Leadership can ameliorate developmental testing—a notoriously complicated bureaucratic maneuver in Air Force circles—by prioritizing the B-21 over legacy platforms and the new jet trainer. If testing and funding remain on track, these efforts should yield

58. Gregory Daddis, *Westmoreland's War: Reassessing American Strategy in Vietnam* (Oxford, UK: Oxford University Press, 2014).

59. Jonathan B. A. Bailey, "Military History and the Pathology of Lessons Learned: The Russo-Japanese War, a Case Study," in *The Past As Prologue*, ed. Williamson Murray and Richard Hart Sinnreich, 1st ed. (Cambridge, UK: Cambridge University Press, 2006), 170–94, https://doi.org/.

60. Tim Trainor, "How Ford's Willow Run Assembly Plant Helped Win World War II," Assembly, January 3, 2019, https://www.assemblymag.com/.

operational B-21s able to employ weapons on practice ranges and potentially be conflict-ready in three to five years, or sooner. In short, the B-21 would be impactful before 2030 and dominant no later than 2035.

Reduce Cost per Kill

Critically, the Department of Defense and Congress should continue their laudable acquisition efforts with some relatively inexpensive modifications, but the primary focus must be reducing the target cost per kill. Fully funding next-generation weapons for even a fledgling B-21 force will unlock more strike efficiency than comparable platforms. And part of this equation is the right weapons-to-platform matching. For example, taking full advantage of the B-2 as a stopgap—perhaps by funding GBU-62 integration as soon as possible—would offer planners an area-targeting option and stimulate tactical creativity.[61]

The hypersonic attack cruise missile and other specialized efforts can remain a priority, but not at the cost of more affordable capabilities or slowing B-21 investment. Numerous studies have proven that a mostly standoff arsenal is unaffordable, even if the previously mentioned limitations inherent to such a force did not exist.[62] Concerns expressed in a RAND Corporation 2011 report that "adversaries may make calculations based on the size of the US missile inventory"—especially given the cost increases associated with building increasingly long-range weapons—must still be taken seriously.[63]

Recalibrate the Combat Air Forces

If the combat air forces are to embrace the unique capabilities of the B-21 in the future, they must destroy the "stealth is dead" mindset, of which the insular B-2 community is partially responsible. Stealth and stand-in platforms are necessary to unlock strike efficiency and affordable mass, and stealth bombers have capabilities their fighter brethren do not. Often when planners think stealth, they typically conflate the B-2 and B-21 with more widely understood fighter characteristics. The remotely piloted aircraft (RPA) community, largely through the RQ-170, has proven the importance of stand-in stealth, but the fighter community is approximately three times larger than the bomber and RPA communities combined.[64] It is only natural that a fighter-led force coerced into standoff preferences might struggle to embrace a new tool such as the B-21.

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61. David Axe, "A Symphony of Bomb Blasts: One after Another, Four Ukrainian JDAMs Apparently Strike Russian Positions in Bakhmut," *Forbes*, April 23, 2023, https://www.forbes.com/.

62. Gunzinger, "Stand In, Standoff."

63. Thomas Hamilton, "Comparing the Cost of Penetrating Bombers to Expendable Missiles over Thirty Years: An Initial Look," RAND Working Papers WR-778-AF, March 4, 2011, https://www.rand.org/.

64. Johnny Franks, "Famous Stealthy RQ-170 'Sentinel' Drone Teams for Combat with B-2 & F-35," Warrior Maven: Center for Military Modernization, December 15, 2023, https://warriormaven.com/; and "2021 USAF & USSF Almanac: Specialty Codes," *Air & Space Forces Magazine*, June 30, 2021, https://www.airandspaceforces.com/.

The Air Force must work now to enable its smart investments in fifth- and sixth-generation stealth fully. Reducing the special accesses required—or easing the read-in process for most tacticians—for current stealth platforms would be an excellent first step. Additionally, directing exercises that require dynamic area targeting in heavily defended airspace is an efficient way to breed tactical creativity and introduce the true level of mission command envisioned by Air Force leadership.

True strategic processes do not begin until combat starts, and history implies wars will not happen where or how leaders expect.[65] The B-21, thanks to its generational leap in stealth technology and modularity, firmly acknowledges that flexibility and adaption are key to victory. Unfortunately, the realities of treating China and its A2/AD efforts as the pacing threat have led the combat air forces to minimize operational challenges that will be critical should a war ignite against any capable opponent: gas is limited, basing is assailable, GPS might not be available, and the space layer is vulnerable. The B-21 offers a chance to reconsider the relationships between stand-in and standoff and embrace a movement toward tactical creativity. ✈

65. Shane Praiswater, "Reconsidering the Relationship between War and Strategy," *RUSI Journal* 168, no. 5 (July 29, 2023), https://doi.org/; and Lawrence Freedman, *Strategy: A History* (New York: Oxford University Press, 2013).

The Airfield as a System

Mark D. Callan

US Air Force airfields are partners in airpower with aircraft, but they are also centers of gravity that cannot maneuver at tempo, making them a potential weakness for adversaries to exploit. If the Air Force is to prevail in great power competition, it needs to rethink airfield organization. Systems thinking can help the Air Force reorganize its airfields into maneuverable rhizomatic teams, mitigating the shortfalls of traditionally organized airfields. This study aims to help Air Force decisionmakers guide the development of airfield systems whose potential has remained relatively unexplored.

When one is asked to visualize American airpower, airfields rarely come to mind. Instead, one would likely conjure the image of a flight of F-100s menacing the skies over North Vietnam, unending streams of C-54 Skytrains breaking Stalin's blockade of West Berlin, or perhaps B-29s lifting off from Tinian to usher in the atomic age of history. Few would consider the outnumbered airfield defenders of Tan Son Nhut airfield repelling waves of North Vietnamese sappers during the Tet Offensive; the constant guiding hand of Tempelhof approach controllers bringing in the endless airflow of the Berlin Airlift; or the resourceful Seabee combat engineers on Tinian island blasting coral to build B-29-capable runways.[1] Airfields are perhaps a less sleek and more subtle reminder of American airpower, but airfields and the service members who defend them, operate them, and build them have always been partners in airpower right alongside aircraft.

Former Chief of Staff of the Air Force General Charles Q. Brown's *Accelerate Change or Lose* action orders are now over three years old.[2] In that time, airfields played critical roles in the Afghanistan retrograde of 2021, Russia's aggression against Ukraine in 2022,

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1. Scott Wakefield, "A Look Back at the 377th Security Police Squadron's Defense of Tan Son Nhut," Air Force Global Strike Command – AFSTRAT AIR, September 22, 2022, https://www.afgsc.af.mil/; "MISSIONS: Tinian," 6th Bomb Group, accessed August 20, 2023, https://6thbombgroup.com/; and Stewart M. Powell, "The Berlin Airlift," *Air & Space Forces Magazine*, June 1, 1998, https://www.airandspaceforces.com/.

2. Charles Q. Brown Jr., *Accelerate Change or Lose* (Washington, DC: United States Air Force [USAF], August 2020).

and the People's Republic of China (PRC) expansionism in the South China Sea in 2023.[3] Yet, airfields are still not organized to best maximize agile combat employment (ACE), as they remain siloed and parochial.

The US Air Force needs to operate and maneuver airfields at tempo to execute ACE successfully, but the service is finding that often it cannot do so fast enough to execute the hub-and-spoke schemes of maneuver. As a result, airfields are putting ACE at risk, and in turn, the nation's ability to prevail in great power competition.

This article argues for a change to this status quo: airfields must be reframed, redefined, and reorganized. First, Air Force leaders must reframe the airfield by acknowledging it is a center of gravity (CoG)—a strategic focal point—with inherent strengths and weaknesses. Secondly, leaders must use a system-of-systems framework to redefine airfields and shape them into systems that mitigate the weakness inherent in CoGs. Finally, the Air Force must reorganize airfields into smaller, rhizomatic weapon systems equipped with a pioneering, mission-driven ethos agile enough to keep pace in great power competition.

Centers of Gravity

Many people think of the airfield as infrastructure that supports operations—a miniature city bustling with the activities of combat airpower generation. Yet consider the distant floating relative of the airfield, the aircraft carrier. Despite its benign name, the aircraft carrier is instantly recognized around the world as a symbol of American naval power. When aircraft carriers sail somewhere, it can be a reassuring gesture for Allies and a not-so-subtle threat to would-be adversaries.

When the Air Force maneuvers an airfield into place, it is an equivalent gesture. Like aircraft carriers, airfields represent a gateway through which forces many time zones away suddenly appear in the local environment, shifting the regional balance of power with little warning. This maneuver and concentration of forces gives air component commanders enormous power and makes the airfield into a natural focal point of airpower. This concentration phenomenon makes an airfield a center of gravity.

Air forces around the world have long understood airfields as CoGs. Early airpower theorist Italian General Giulio Douhet wrote in 1927 about both the unparalleled offensive potential of aircraft as well as the relative vulnerability of aircraft when they returned

3. Clayton Thomas et al., *U.S. Military Withdrawal and Taliban Takeover in Afghanistan: Frequently Asked Questions*, R46879 (Washington, DC: Congressional Research Services, updated September 17, 2021), https://crsreports.congress.gov/; Bradley Martin, D. Sean Barnett, and Devin McCarthy, *Russian Logistics and Sustainment Failures in the Ukraine Conflict* (Santa Monica, CA: RAND Corporation, 2023), https://doi.org/; Liam Collins, Michael Kofman, and John Spencer, "The Battle of Hostomel Airport: A Key Moment in Russia's Defeat in Kyiv," *War on the Rocks*, August 10, 2023, https://warontherocks.com/; and "China Appears to Be Building an Airstrip on a Disputed South China Sea Island," AP, August 17, 2023, https://apnews.com/.

to land at the "nest."[4] Though the vulnerability of airfields has been implicitly understood for decades, a deeper discussion on what explicitly makes airfields a center of gravity is warranted, because there is little contemporary literature or Air Force doctrine that explains why. Reframing airfields as CoGs sets the stage for redefining airfields as systems-of-systems before reorganizing them into something more rhizomatic and pioneering.

Classical Application to Airfields

The term center of gravity translates from the German *ein Zentrum der Kraft und Bewegung*.[5] The term was borrowed from physics by Carl von Clausewitz in the early-nineteenth century and describes a point of cohesion in an enemy where a striking blow would prove most effective. The intent of the Newtonian metaphor was to echo the effect of a physical blow against an object's literal center of gravity.[6] Clausewitz's center-of-gravity metaphor has endured from the Napoleonic era and still finds use among military theorists and practitioners today. It remains a central concept in Joint warfighting doctrine.[7]

Using this classic notion as discussed by Clausewitz reveals four reasons why airfields are centers of gravity: (1) airfields contain the mass of Air Force forces and act as a hub, (2) airfields are central to the maneuver of Air Force forces and ground forces, (3) the geographical location of airfields determines how air campaigns are waged, and (4) airfields can exert economic and political influence during peacetime as well as wartime.

Mass. Tactically and operationally speaking, airfields contain the mass of Air Force forces and serve as a hub of activity. Aerial ports, air traffic control towers, aircraft maintenance hangars, fuel farms, runways, taxiways, aprons, navigational aid facilities, and the airfield's airspace maintain the highest concentration of forces at the point at which aircraft and personnel are at their most vulnerable for the longest period of time—sitting ducks, in other words.[8]

Maneuver. In terms of logistics, airfields can send and receive inter- and intra-theater logistics airflow. The ability to maneuver forces from one part of the world to another at the speed of airlift is what gives the US military a global versus regional influence. Joint forceable entry operations such as airfield seizures have been used throughout the history

4. Giulio Douhet, *The Command of the Air,* trans. Dino Ferrari (Maxwell AFB, AL: Air University Press [AUP], 2019), https://www.airuniversity.af.edu/.

5. Joseph L. Strange and Richard Iron, "Center of Gravity: What Clausewitz Really Meant," *Joint Force Quarterly* 35 (2004).

6. Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton: Princeton University Press, 1989).

7. *Joint Planning*, Joint Publication (JP) 5-0 (Washington DC: Chairman of the Joint Chiefs of Staff, December 1, 2020).

8. Alan J. Vick, *Snakes in the Eagle's Nest: A History of Ground Attacks on Air Bases* (Santa Monica, CA: RAND Corporation, January 1, 1995), https://doi.org/.

of airpower.[9] Some examples include Russia's attempted seizure of Hostomel Airport in the opening days of its invasion of Ukraine (2022), the US seizure of Rio Hato Airfield during its invasion of Panama (1989), and the Nazi Airborne jump operations on Maleme airfield in Malta during World War II (1941).[10]

Geography. The Air Force needs an airfield, airspace, aircraft, and many other systems to project airpower. Airfields are the keystone support system that make airpower work. The location of the airfield changes how airpower is employed. Airfields that are close to the adversary pose different risks to mission and force than airfields that are distant. Each has its own advantages and disadvantages. During World War II, Soviets favored airfields close to the front lines of their advance because proximity gave their air forces the agility they required to execute combined arms against the Germans.[11] During Operation Odyssey Dawn, however, the US Air Force used B-1Bs from Ellsworth Air Force Base, South Dakota, to strike targets in Libya by flying sorties from the continental United States to North Africa.[12]

Influence. Airfields exert economic and political influence, and they can do so outside of war. Unlike fighters and bombers which can only kill enemies, practice killing enemies, or fly near adversaries to remind them that they can kill enemies, airfields controlled or operated by the military can also be used for a range of operations that are below the continuum of armed conflict. Examples include humanitarian assistance airlift operations following the 2005 earthquake in Pakistan, which tangibly and positively affected the state's short-term opinion of the United States, and China's construction of a ring of airfields in the South China Sea to exert greater control over territorial claims.[13]

Contemporary Application to Airfields

Contemporary center-of-gravity theory focuses on thinking of CoGs as systems that can be broken down into subsystems, analyzed for weaknesses and then targeted. The Air Force associates systems-based CoG thinking with Colonel John Warden, who applied his five-rings targeting methodology while planning air campaigns against Iraq. After the

9. R. F. M. Williams, "The Development of Airfield Seizure Operations in the United States Army," *Military Review*, November 2021, https://www.armyupress.army.mil/.

10. Collins, Kofman, and Spencer, "Hostomel Airport."

11. Martin van Creveld, Steven L. Canby, and Kenneth S. Brower, *Air Power and Maneuver Warfare* (North Charleston, SC: CreateSpace Independent Publishing Platform, 2012).

12. Steven J. Merrill, "Ellsworth Airmen Recall Historic Mission 10 Years Later," Ellsworth Air Force Base, March 27, 2021, https://www.ellsworth.af.mil/.

13. *Competition Continuum*, Joint Doctrine Note 1-19 (Washington, DC: CJCS, June 3, 2019); Kali Gradishar, "CRE Airmen in Pakistan Relate 2005 Earthquake to 2010 Flood Operations," Air Mobility Command, October 12, 2010, https://www.amc.af.mil/; and Jennifer D. P. Moroney, *Lessons from Department of Defense Disaster Relief Efforts in the Asia-Pacific Region* (Santa Monica, CA: RAND Corporation, 2013).

success of Operation Desert Storm, contemporary thinking about CoGs grew conceptually from culminating battles against focal points to include systems-based warfare.[14]

Another scholar highlights seven common but not universal systems around which contemporary CoG literature tends to coalesce: fielded military, leadership, industry, infrastructure, population, public opinion, and ideology.[15] The Air Force and Western military thinkers understand the weaknesses of CoGs—as do potential adversaries. The PRC has grown a systems-based framework of warfare directly in response to the Western use of systems-based targeting frameworks such as Warden's rings or other contemporary CoG analyses.[16] Essentially, centers of gravity like the airfield can be broken down into subsystems, analyzed for weaknesses, targeted, and neutralized.[17]

On a practical level, Air Force planners understand the threat adversaries pose. They know that wrestling for air superiority often requires maneuvering their aircraft and ground forces against an adversary. Allies in World War II, notably the American Air Forces of the South Pacific, maneuvered in conjunction with Australian ground forces from airbase to airbase, fighting against Imperial Japanese forces setting up decisive engagements like the Battle of the Bismarck Sea.[18] Ample Gain, a Cold War series of Allied aircraft cross-servicing events and forerunner of agile combat employment, used the robust network of NATO airbases to maneuver combat aircraft around what would be recognized today as a base cluster.[19] Ample Gain worked because of robust airfield infrastructure, a large network of NATO bases, and interoperable combat support functions.

The Air Force's current strategy of agile combat employment, "a proactive and reactive operational scheme of maneuver executed within threat timelines to increase survivability while generating combat power," relies on the dispersion of airpower from a main operating base into basing clusters to complicate enemy targeting.[20] Unlike Ample Gain, ACE maneuvers both aircraft and airfields to complicate targeting while generating opportunity.

In terms of airfields and CoGs, the Air Force uses ACE to hedge against the inherent vulnerabilities of large, static airfields by relying on the speed and surprise of maneuverable airfields. ACE requires both Air Force aircraft and ground forces to simultaneously

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14. Jeffrey Engstrom, *Systems Confrontation and System Destruction Warfare: How the Chinese People's Liberation Army Seeks to Wage Modern Warfare* (Santa Monica, CA: RAND Corporation, 2018), https://doi.org/.

15. Miha Šlebir, "Re-Examining the Center of Gravity: Theoretical and Structural Analysis of the Concept," *Revista Científica General José María Córdova* 20, no. 40 (December 2022), https://doi.org/.

16. Engstrom, *Systems Confrontation*; John Warden, "The Enemy as a System," *Airpower Journal* 9, no. 1 (1995); Joe Strange, *Centers of Gravity & Critical Vulnerabilities: Building on the Clausewitzian Foundation So That We Can All Speak the Same Language*, 2nd ed. (Darby, PA: Diane Publishing, 1996); and JP 5-0.

17. Warden; and Strange.

18. Thomas E. Griffith Jr., *MacArthur's Airman: General George C. Kenney and the War in the Southwest Pacific*, 1st ed. (Lawrence: University Press of Kansas, 1998).

19. *Joint Air Power following the 2016 Warsaw Summit: Urgent Priorities* (Kalkar, Germany: Joint Air Power Competence Centre, October 27, 2017), 98, https://www.japcc.org/.

20. *Agile Combat Employment*, Air Force Doctrine Note 1-21 (Washington, DC: Department of the Air Force [DAF], August 23, 2022), 1, https://www.doctrine.af.mil/.

maneuver in response to emergent threats. Maneuver of aircraft via flush—a type of launch-for-survival—is a skillset that aircraft had before ACE and one that aircraft still practice. Yet, Air Force ground forces cannot keep pace because rapid reactive or proactive maneuver of ground forces in response to emergent threats is still not a cultural norm in the Air Force.

Reframing airfields as CoGs in the classical sense and in the contemporary sense provides two key insights. First, in the classical sense, airfields have a cohesive identity as a system that military commanders can employ to achieve effects. Second, in the contemporary sense, airfields can be dissected into subsystems and targeted by adversaries. The Air Force understands this and actively tries to mitigate this via schemes of maneuver such as ACE.

Systems-of-Systems

Contemporary Wardian CoG analysis hints at the systems-based thinking paradigm used to define many of society's and nature's complex systems. The Air Force needs to think of airfields as systems so the service can reorganize them into systems that mitigate their historical vulnerability. The system-of-systems framework breaks down complex systems such as airfields, allowing the Air Force to understand and reshape them.

Airfield systems possess five characteristics appropriate for the system-of-systems designation: operational independence, managerial independence, geographic distribution, emergent behavior, and evolutionary development.[21]

Operational Independence

This characteristic is straightforward when looking at airfields. A system is made of separate component systems that are capable of independent operation. Military airfields are meta systems with component systems, and they themselves are component systems in a larger system. As meta systems, they contain component systems such as radar systems, air traffic control facilities, pavement systems, and lighting systems. Each of these provides use independent of the others.[22] Airfields are also component systems of larger systems like the National Airspace System (NAS), within which an airfield operates independently of the others.[23]

Managerial Independence

Component systems are acquired and integrated into a meta system to achieve a specific purpose. At first glance, military airfields can seem like integrated monolithic entities

21. Andrew Sage and Christopher Cuppan, "On the System Engineering and Management of Systems of Systems and Federations of Systems," *Information-Knowledge Systems Management* 2 (December 1, 2001).

22. Sage and Cuppan.

23. "National Airspace System," Federal Aviation Administration (FAA), last updated April 20, 2023, https://www.faa.gov/.

under the control of a commander; however, airfields are managerially independent of the systems they are administratively grouped with. An apt example comes from comparing Chicago O'Hare International Airport to Travis Air Force Base (AFB). The more federated civil airfield of O'Hare has a diverse and loosely affiliated ecosystem of agencies that interact for the common goal of generating economic activity.

O'Hare's airfield, aircraft, logistics operations, housing communities, and security functions are all distinct component systems required for the airport to function. As noted, the airfield's systems are run by a loose, federated mix of government, commercial, and private organizations. Geographically, some of these systems are not run or located out of Illinois, much less O'Hare itself, but they all collaborate to produce safe, efficient airflow and economic activity that benefits the region.[24]

O'Hare's comparatively more federated organization contrasts with the 60th Air Mobility Wing at Travis AFB. Travis is geographically concentrated and under the management of a wing commander. The wing at Travis AFB has aircraft, an aerial port, security forces, and basing facilities—including gyms, restaurants, and housing—all within approximately a mile of the airfield. At first glance, the military airfield appears completely integrated with the rest of the installation under the command of the wing commander.

Yet upon closer inspection, the airfield and its airspace are unique from the other parts of Travis AFB. The airfield is part of the NAS, which provides regulatory oversight over portions of airfield operations. The airfield has its own specialty fire-fighting equipment and crews, distinct engineering regulations, and specific force protection requirements. Although the wing commander at Travis has command of its airfield, the authorities, resourcing, and systems used to run the airfield are not interchangeable with those used to run the basing. Thus, it can be said that the airfield at Travis AFB can operate independently of the attached base.

Geographical Distribution

The system is often geographically spread out and connected via information exchange. Airfield operations stretch from the surface to the top of an airfield's airspace. They extend from an airfield's center point to the edges of approach airspace. Yet component systems that support the airfield system may be located several feet underground, such as the airfield lighting system, to several hundred miles above the airfield, such as position, navigation, and timing satellites. Other typical examples of geographically distributed component systems include radar towers placed on nearby hills serving airfields in their proximity, or command-and-control centers located thousands of miles away.

24. Matt O'Shea, "Ald. Matt O'Shea: O'Hare's Facilities Are Aging. Terminal Expansion Plans Are Crucial to Move Chicago Forward," *Chicago Tribune*, January 11, 2024, https://www.chicagotribune.com; and "Great Lakes Region," FAA (website), last updated March 11, 2024, https://www.faa.gov/.

Emergent Behavior

The system has capabilities that do not reside within the component systems. The career fields and component systems of air traffic control; radar, airfield, and weather systems maintenance (RAWS); and airfield management cannot run an airfield by themselves. When they are combined into a flight and unified under the control of an airfield operations officer, however, they produce the emergent property of airfield operations.[25] The Air Force did not mastermind the creation of the airfield operations flight, but rather, air traffic control was combined with airfield management and RAWS over a series of years to meet the emergent demands of running an increasingly complex airfield system. Over time, the chief air traffic control officer came to run the airfield management and RAWS sections and slowly evolved into the airfield operations officer known today.

Understanding the airfield system and airfield operations as emergent might help explain why the Air Force does not have a stand-alone body doctrine that describes airfield operations. There are unique behaviors and properties of airfield systems which might be considered universal to airfield systems:

a. They function as adaptable, evolving weapon systems that project tactical-, operational-, and strategic-level airpower effects.

b. They perform the function of "anchoring" military air operations to a local terminal node that concentrates and projects forces into the air and land domains, and potentially space.

c. They are configurable to meet mission, community, and stakeholder needs.

d. They are portals between the land, air, and even space domains, just as the airfield's floating cousin, the aircraft carrier, is a portal between the maritime and air domains.[26] Airpower effects and commerce pass through the airfield and influence the ground space, airspace, and political space around them.

e. They contain infrastructure component systems, but they are not solely infrastructure.

Evolutionary Development

The system grows and evolves over time, never fully forming. Airfields evolve by adding or specializing their component systems. They change in response to their stakeholders,

25. Sage and Cuppan, "System Engineering."

26. Sandra Erwin, "SpaceX Wins $102 Million Air Force Contract to Demonstrate Technologies for Point-to-Point Space Transportation," *SpaceNews*, January 19, 2022, https://spacenews.com; Jane Edwards, "SpaceX Awarded $102M AFRL Rocket Cargo Contract," GOVCONWIRE, January 20, 2022, https://www.govconwire.com; and Mike Wall, "US Military's X-37B Space Plane Lands, Ending Record-Breaking Mystery Mission," Space.com, November 12, 2022, https://www.space.com.

nearby communities, and both natural and humanmade threats. An example is Afghanistan's Kandahar Airfield, an airfield built for piston engine aircraft in the 1960s. Kandahar expanded and changed under Soviet use in the 1980s to accommodate higher performance aircraft.[27] It expanded again under American use in 2001, and Kandahar continues to change after the American withdrawal from Afghanistan.

Understanding the airfield as a system of systems helps explain airfield system behavior. The system-of-systems framework also delineates the basic component systems (table 1). An understanding of these basic building-block categories enables the reorganization of airfield systems as CoGs to overcome their inherent weaknesses.

Table 1. Typical airfield component systems

Categories of Systems	Examples	Narratives
operational surface systems	helipad, runway, launch pad, grass strip	operational surface that launches and recovers air/spacecraft
air traffic control, landing guidance, and weather systems	tactical air navigation (TACAN), RADARs, terminal instrument procedures/(non) precision approaches, GPS	family of systems that guides, senses, and detects aircraft or weather conditions in the terminal environment; provides command and control of aircraft
command, control, communication systems	tactical operations center	leads, manages airfield system, conducts C4ISR, early warning, personnel reporting
emergency service system	airfield rescue and firefighting, basic medical care, crashed, damaged, or disabled aircraft recovery (CDDAR), explosive ordnance disposal (EOD), rapid airfield damage recovery (RADR)	systems that provide emergency response, basic medical, triage, and recovery services necessary to resume normal airfield operations

Two things are apparent in table 1. First, some systems on the airfield necessary to airpower do not support airfield operations—for example, aerial port facilities. Second, some systems and capabilities necessary to airfield operations are outside the typical airfield operations organization—for example, civil engineering pavements and airfield lighting technicians.[28] Of note, the component systems in table 1 correspond with the role of the "Senior Airfield Authority." Additionally, there are some civil engineering functions such as airfield rescue fire fighting required to perform airfield operations that fall under the Senior Airfield Authority's counterpart, the Base Operations Support Integrator. The current organizational hierarchy used to run airfields is thus coordination intensive and complex.

27. Monica Whitlock, "Helmand's Golden Age," BBC, August 7, 2014, https://www.bbc.co.uk/; and National Photographic Interpretation Center, "Imagery Analysis Report: Disposition of Soviet Air Forces in Afghanistan and in the USSR along the Afghanistan Border Area as of [redacted]," Z-20056/80, IAR-0173/80, declassified report (Washington, DC: Central Intelligence Agency, August 1980), https://www.cia.gov/.

28. *Contingency Basing*, JP 4-04 (Washington, DC: CJCS, January 4, 2019).

Reorganizing Airfields

The system-of-systems framework clarifies what an airfield is, what it does, and what component systems make up the airfield. The next step is reorganizing those airfield component system building blocks to mitigate CoG-related critical weaknesses. Military structures are typically organized into a hierarchical structure like a chain of command.

One contemporary design scholar refers to such a structure as a root-tree form of organization.[29] Root-tree hierarchies form organizations which tend to develop into CoGs. An alternative hierarchical form to the root-tree form is the rhizome form of organization. A more rhizomatic form will typically "encompass ideas paradoxical to centralized hierarchical forms, such as 'self-organized,' 'decentralized,' 'nonlinear,' 'lacking order,' and 'irregular' or 'asymmetric'—terms often used in complex security challenges."[30] Rhizomatic organizations are more akin to loosely organized structures that break apart, reform, and scale as required to accomplish their goal, before breaking apart again.[31] Changing these hierarchical forms of organization starts with understanding what each excels at.

Root-Tree Form

In the root-tree form, the "trunk" of the tree is a centralized focal point of organization that governs the "branches" growing off the trunk.[32] US military airfield systems currently are organized according to the root-tree system. In fact, root-tree hierarchy is the organizing principle of Air Force bureaucracy. In a typical wing, flights are nested under squadrons, which are nested under groups, which are nested under the wing. The wing commander is the focal point of decision and leadership. The wing commander is represented by the trunk where the branches all grow from. Airmen executing the mission represent the end branches farthest from the trunk. Once Airmen learn the root-tree logic of wing organization, they can walk into any squadron and understand how a squadron in a different wing is organized in a similar way.

Air Force airfields—root-tree organizations—and the rest of the entities operating on the airfield adhere to a standard military hierarchy that values efficiency.[33] Each function-based organization builds its own separate and parallel hierarchy. Each "siloed" hierarchy in these function-based organizations has independent versions of specialized workers, supervision, command posts, and so on.

The airfields' industrial-era Taylor-esque silos organize these systems in a root-tree form. This works well when a typical sequence of aircraft operations occurs: an aircraft

29. Ben Zweibelson, *Beyond the Pale: Designing Military Decision-Making Anew* (Maxwell AFB, AL: AUP, 2023), https://www.airuniversity.af.edu/.

30. Zweibelson, 225.

31. Zweibelson.

32. Zweibelson.

33. Stanley McChrystal et al., *Team of Teams: New Rules of Engagement for a Complex World,* 1st ed. (New York: Portfolio, 2015); and Zweibelson.

coordinates to arrive at the airfield; the aircraft enters the airfield's airspace, lands, and taxis to a predetermined parking spot; the aircraft and crew are regenerated; then the aircraft taxis, takes off, and exits airspace. This sequence is aircraft-centric—that is, processes are organized with reference to the aircraft—and each individual step in the process is supported by a specialized system with its own hierarchy.

This sequence of operations runs on procedural flow with respect to the aircraft and does not emphasize communications and relationships between systems in the sequence. The result is that each specialized system has its own way of coordinating with the aircraft. For example, during the flight back to an airfield an aircraft might communicate with a military-owned approach control, an air traffic control tower, supervisor of flying, a maintenance operations center, an air terminal operations center, the airfield management desk, and a base's command post.

Rhizome Form

True agility will require the Air Force to change the form of its hierarchies. Root-tree form hierarchies have their virtues and efficiencies, but the structure is not optimal for producing small interdisciplinary teams that can effectively execute agile combat employment. The functional silos resulting from root-tree hierarchies are incentivized and organized to build connections vertically within the silo from the tactical up through the operational and strategic levels of war.

Generating flexible teams capable of ACE in response to a dynamic threat will require the Air Force to integrate an alternate form of organization known as the rhizome type. The rhizome is a horizontal root system capable of producing new shoot-and-root plants aboveground from the same root system underground, such as turmeric or ginger plants.[34] The effect is that one root system grows plant systems distributed across the ground, creating a resilient network.

Rhizome form, compared to the Aristotelian root-tree form, represents a postmodern means of organizational hierarchy. One analysis uses the analogy of the traditional library network versus the hyperlinked nature of the internet to characterize the root-tree-to-rhizome comparison.[35] In deconstructing why the Joint Special Operations Task Force retired Army General Stanley McChrystal commanded from 2003 to 2008 initially failed to decisively counter al-Qaeda in Iraq (AQI), a violent extremist jihadist organization, McChrystal and his coauthors point to the root-tree characteristics of the US military versus the rhizomatic nature of the jihadist network.[36] To match the adaptability and tempo

34. *Encyclopaedia Brittanica Online*, s.v., "Rhizome," last updated March 22, 2024, https://www.britannica.com/.

35. Lyn Robinson and Mike Macguire, "The Rhizome and the Tree: Changing Metaphors for Information Organisation," *Journal of Documentation* 66, no. 4 (2010), https://doi.org/.

36. McChrystal et al., *Team of Teams*.

of the inherently horizontal, rhizomatic, and dispersed al-Qaeda insurgency, McChrystal transformed the task force command structure into a flatter, more horizontal hierarchy. [37]

The vast majority of airfield systems are organized in a root-tree hierarchy and struggle to adapt and maneuver at tempo against adversaries. Yet today there are a select few airfield systems that can maneuver and adapt; these systems are notably rhizomatic. Contingency response is one such organization.

Contingency response forces are what the Air Force calls an "open the base" force, although this is somewhat of a misnomer.[38] They deploy to a location and, as long as the location has a suitable surface to land aircraft on, these forces open an airfield. Generally, once an airbase is opened, strategic and tactical airlifters such as the C-17 and C-130 start landing and flowing personnel and materiel through the airfield, which serves as an aerial port of debarkation.

Of note, contingency response teams only bring enough base operations support equipment to support themselves for approximately 45 to 60 days. The bed down of contingency response personnel is completely dependent on the terrain, the enemy, and the existing structures proximate to the airfield. Generally speaking, however, they will bed down in the immediate vicinity of the airfield they are operating.

Contingency response forces train in garrison to ingress to a potential airfield site, assess the airfield, and then receive fixed-wing mobility aircraft. A contingency response squadron has a cross-section of aircraft maintenance, security forces defenders, aerial port logistics, fuels, airfield operations, communications, civil engineering, command and control Airmen, and other specialized Airmen who provide services such as weather forecasting and defense against chemical, biological, radiological, nuclear threats.

A typical contingency response group is made up of contingency response squadrons and support squadrons. Groups have 36 unique Air Force Specialty Codes (AFSCs) of Airmen and train their Airmen to work in small, functional teams. These teams are not specific hierarchical silos. Rather, contingency-response teams are a cross-section of all the hierarchies by design.

In terms of system classification, contingency response forces are a system-of-systems made up of many diverse component systems. The main component systems used for military airfield operations are an airfield system, a logistics system, an aircraft system, and a force-protection system.

For example, a contingency-response team is a deployable team of Airmen that belongs to a contingency response squadron. The team of roughly 22 to 25 Airmen is typically led by a senior noncommissioned officer. This team can assess and open an airfield, sustain and protect itself at that airfield, perform air traffic or landing zone operations, perform airfield management, perform basic survey and civil engineering functions, exercise

37. Zweibelson, *Beyond the Pale*.

38. *Air Mobility Operations*, Air Force Doctrine Publication 3-36 (Washington, DC: DAF, June 28, 2019), Appendix C: Air Mobility Support and Contingency Response Elements.

command and control of an airfield, and perform continuous aerial port operations, one aircraft at a time for 12 hours.[39]

Because contingency response teams have aerial port logistics built into the structure, they can pack up their footprint and move themselves via airlift. This ability may seem mundane, but it is what makes these teams maneuverable. Most other squadrons in the Air Force—and indeed, across the entire Joint force—do not have this ability because it does not fall into their specialized siloed hierarchy. Most Air Force units do not have the know-how and specialized aerial port personnel and materiel to move themselves, and as a result, they cannot maneuver themselves out of harm or into an advantageous position.

Contingency response teams, like rhizomes, are dynamic. The traditional vertical root-tree airfield hierarchies are largely dissolved and flattened. Teammates share larger amounts of interoperability, allowing them to perform airfield, logistical, maneuver, and combat operations while maintaining a smaller footprint. These teams can combine with each other, and with a few additional personnel added as a coordination overhead, they can scale to form larger elements. For the ACE base cluster use case, the ability of contingency response teams to move themselves via airlift is ideal. They can be thought of as a well-rounded system of systems that open an airfield system to execute logistics and—when it is time to maneuver—as a logistics system that configures itself into self-loading cargo.

Figure 1 compares rhizomatic airfield systems such as contingency response teams to their root-tree form hierarchical counterparts. While not an exhaustive list of component systems that form these teams or air task forces, the figure illustrates the differences between root-tree and rhizomatic system-of-system groupings. The alpha level cannot be broken down further; the delta level represents groupings whose component systems are themselves systems of systems. The levels of system groupings (alpha, beta, etc.) denote the level of complexity, with alpha representing the simplest system level and delta the most complex.[40]

The Air Force needs more airfields that can maneuver themselves in small rhizomatic packages—airfield systems that look a lot like contingency response teams. These airfields would feature component systems from aircraft, logistics, force protection, basing, and other airfield systems to establish a system capable of projecting airpower in the right place and at the right time.

Such rhizomatic maneuverable airfields systems must be produced in large enough quantities that they can form networks of homogenous contingency response teams which can then combine or separate into diffused networks of airfields that maneuver in conjunction with aircraft. This network would support and complement the large, static, and root-tree-form main operating bases. The teams could move along the axis of advance, executing the ground scheme of maneuver in an air campaign.

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39. *Contingency Response*, Air Force Tactics, Techniques, and Procedures 3-4.7 (Washington, DC: Secretary of the Air Force, March 3, 2022), https://static.e-publishing.af.mil/.

40. D. A. DeLaurentis, "A Taxonomy-Based Perspective for Systems of Systems Design Methods," *Proceedings of the 2005 IEEE International Conference on Systems, Man and Cybernetics* 1 (2005), https://doi.org/.

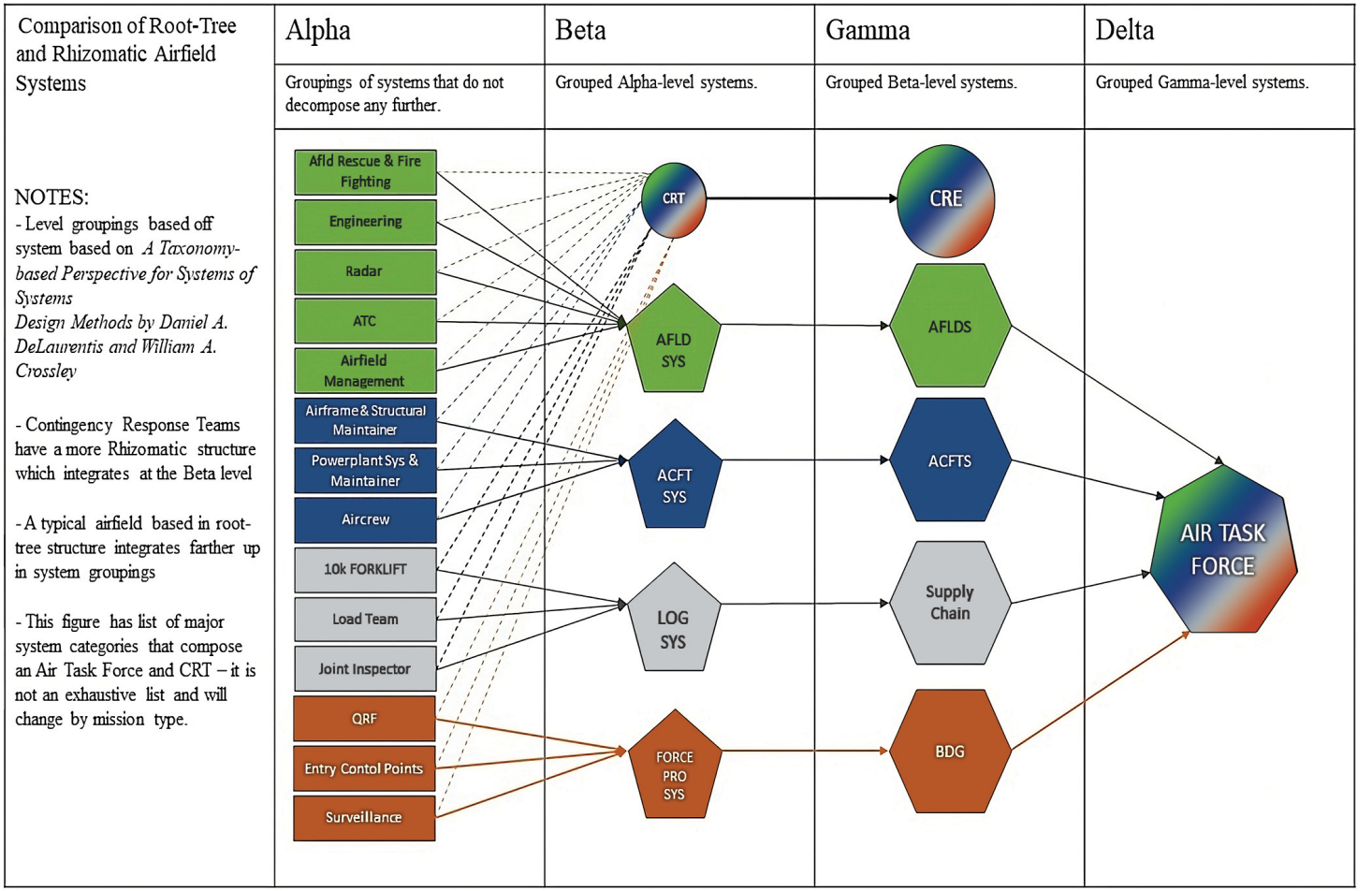

Figure 1. Rhizomatic and root-tree system-of-systems groupings

Pioneer Culture

The Air Force must invest in the culture required to operate maneuverable airfields. This starts with creating an organization that supports a pioneering ethos, which is a prerequisite for scaling the number of rhizomatic organizations. Such a shift to a rhizomatic culture calls for teams staffed with strategically aware, high-initiative noncommissioned officers operating alongside company and field grade officers who are technically adept. This flattened rhizomatic organization would comprise self-sufficient, mission-driven problem solvers who get the job done creatively and effectively in a dynamically unfolding environment. These so-called Pioneer teams would be comfortable operating on their own initiative in maneuvering and executing the mission.

Pioneer teams would live on the edges of the known and unknown, providing a maneuverable airfield capability. Pioneer teams are not envisioned as special operational forces (SOF). In the Air Force context, they would be the forces that bridge the gap between SOF and the cultural mainstream of the Air Force. Pioneer team culture should be slightly more discerning than traditional Air Force forces but more scaled and reproducible than SOF. Individual Pioneers would value resiliency, self-sufficiency, technical acumen, and initiative. Pioneer teams would value flat communication, aggressive problem solving, and cross-trained skill redundancy, such that each individual team member would be a jack-of-a-few-trades and the master of one.

Contingency response forces in Air Mobility Command, Pacific Air Forces, US Air Forces in Europe, the Air National Guard, and Air Force Reserve have already started to foster the pioneering spirit by organizing Airmen into diverse squadrons built around the contingency response mission, creating a contingency-response Airmen identity. The Air Force must amplify this effect and supplant its primary AFSC identity with the contingency-response identity. Contingency-response Airmen must become contingency-response Airmen first and foremost via distinctive AFSCs, dress, and organizational values.

Finally, the Air Force should change the promotion system to value pioneer thinking and values while creating viable career paths that recognize Airmen who excel in flat, rhizomatic organizations. The traits that would help Pioneer Airmen excel in dynamic environments are different than those of Airmen who excel in the traditional root-tree hierarchy.[41] Contingency response Airmen would be ideal Pioneer Airmen. A Pioneer corps would accelerate organizational learning and reinforce the ethos required to execute rhizomatic "team-of-teams" hierarchies. Finally, it would allow the Air Force to obtain a higher return on investment when teaching specialized perishable skills in a multicapable Airmen setting—skills such as specialized fueling operations, landing-zone operations, shoot-move-communicate, advanced field craft, or weighing, marking, and joint inspection.

41. Stephen Peter Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca, NY: Cornell University Press, 2018).

Recommendations and Conclusion

The Air Force needs to increase the number of contingency-response-team-like rhizomatic airfield systems to complement the Air Force's existing network of static airfields. A Pioneer organization could focus on the organization, train, and equip mission for all contingency response and contingency-response-like maneuverable airfield mission sets within the Air Force. How should the Air Force tailor its systems? How does it expand the contingency-response rhizomatic concept across the Air Force? The recommendations are threefold.

First, the Air Force needs to make the airfield a major weapon system akin to other nonaircraft weapon systems, such as the Guardian Angel Weapon System, used for combat search and rescue and personnel recovery. Although the airfield has long been acknowledged informally as such within the Air Force, the service-wide designation of airfields as weapon systems is a necessary step to accelerate their development. Such a designation is also a step in the right direction toward running the enterprise of airfields that range from the large, static root-tree systems to the small, rhizomatic maneuverable systems.

Secondly, similar to other Air Force nonaircraft weapon systems, contingency-response-team-like maneuverable airfield systems should be associated with organic airlift. Organic airlift allows maneuverable airfield systems to seize the initiative when they sense a window of opportunity or reposition when in imminent danger. This point is only reinforced by challenges in the Indo-Pacific where the tyranny of distance, the possibility of degraded command and control, and the threat of near-peer aggression emphasize the need for the ability to rapidly maneuver.

Lastly, Air Force leaders should capitalize on the effectiveness of maneuverable airfield systems that can perform agile combat employment by integrating airfield systems into Joint all-domain command and control. Airfields are natural platforms for command-and-control-related functions since position, navigation, and timing and two-way communication equipment are required for all-weather airfield operations.

Airfields work hand in hand with aircraft to project airpower. The Air Force needs rhizomatic airfield systems similar to contingency response teams, which are powered by a pioneer ethos to maneuver and project airpower while mitigating the critical weaknesses associated with them as centers of gravity. The Air Force must invest in the unique programs, cultures, and values required to maneuver airfields to succeed in today's great power competition. ✈

Analytic Standards in the Context of Military Intelligence

Jack Duffield

Scholarship of analytic standards generally focuses on their application in strategic intelligence assessments. Yet analytic standards are underexplored in other environments, particularly tactical and operational military intelligence analyses. These environments challenge many assumptions that generally underpin the implementation of analytic standards, including multi-analyst quality control chains and a focus on rigor as the primary measure of quality. The US Air Force's implementation of analytic standards offers an illustration of how such standards can be applied in military intelligence environments. To successfully employ analytic standards in tactical and operational intelligence environments, emphasis must be placed on accrediting analysts themselves as well as their output. The rigor-led model of analytic standards must also be broadened to give greater weight to other attributes of quality intelligence analysis.

Analytic standards for intelligence analysis gained prominence in the revelations of the structural intelligence failures preceding 9/11 and the flawed assessment of the presence of weapons of mass destruction (WMD) in Iraq. These two high-profile intelligence failures prompted much soul-searching in Western intelligence organizations.[1] A consensus emerged that a long-term decline in the quality of intelligence analysis and assessment had occurred, which could only be reversed by implementing new processes and principles.[2]

This course of events resulted in the development of standards for intelligence analysis, particularly in the United States and United Kingdom.[3] The Office of the Director of National Intelligence's (ODNI) Intelligence Community Directive (ICD) 203, for example, calls for intelligence products to be objective, independent of political consideration, timely, based on all available sources of information, and in line with further specific

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1. John A. Gentry, "Has the ODNI Improved U.S. Intelligence Analysis?," *International Journal of Intelligence and CounterIntelligence* 28, no. 4 (2015), https://doi.org/.

2. Alexandru Marcoci et al., "Better Together: Reliable Application of the Post-9/11 and Post-Iraq US Intelligence Tradecraft Standards Requires Collective Analysis," *Frontiers in Psychology* 9 (2018): 1, https://doi.org/.

3. David R. Mandel, Tonya L. Hendriks, and Daniel Irwin, "Policy for Promoting Analytic Rigor in Intelligence: Professionals' Views and Their Psychological Correlates," *Intelligence and National Security* 37, no. 2 (2022), https://doi.org/.

standards including common terminology for uncertainty and confidence levels.[4] Such standards are designed to improve the quality and effectiveness of intelligence analysis across the US Intelligence Community (IC). Yet these standards—still in place today—focus heavily on intelligence analysis at the strategic level. This is unsurprising, given that they were developed in response to strategic intelligence failures; however, this focus brings into question their relevance for intelligence analysis outside of this context.

Strategic intelligence has an intuitive meaning: it generally describes intelligence activities that are of interest to political leaders at an international level.[5] It is in this context that the term strategic is generally used by scholars of intelligence studies. This reflects military terminology, where the strategic level incorporates government-wide priorities and international concerns, and intelligence analysis influences the highest level of decision-making.[6]

Military doctrine defines two other levels of activity below this—operational and tactical—where military campaigns are organized and where individual missions are planned and executed, respectively.[7] Military intelligence analysts are expected to work across all three levels of activity. Yet in addition to a general lack of scholarship on military intelligence, there is a notable academic bias in favor of the strategic level of intelligence analysis. This makes studying analytic standards for military intelligence particularly challenging.[8] This article aims to address this gap in the understanding of analytic standards by exploring their application in operational- and tactical-level intelligence environments.

Because of the relative lack of scholarship on military intelligence in intelligence studies, this article takes a comprehensive approach to this exploration, deconstructing the concept of analytic standards and exploring its core characteristics, thus determining their applicability beyond the strategic level. These characteristics demonstrate that the rigor-led approach to analytic standards does not apply sufficiently to tactical and operational intelligence environments, and alternative means of enforcing standards, such as those used by the US Air Force, are necessary to overcome this limitation.

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4. *Analytic Standards,* Intelligence Community Directive (ICD) 203 and Technical Amendment (McClean, VA: Office of the Director of National Intelligence [ODNI], 2015, 2022), 2–3, https://www.odni.gov/.

5. Loch K. Johnson, *Handbook of Intelligence Studies* (London: Routledge, 2007), 1.

6. UK Ministry of Defence (MOD), *Allied Joint Doctrine*, NATO Allied Joint Publication-01, F ed., v. 1 (Bristol, UK: MOD and NATO Standardization Office, 2017), 1–9, https://assets.publishing.service.gov.uk/; and *UK Defence Doctrine,* Joint Doctrine Publication (JDP) 0-01, 6th ed. (Bristol, UK: MOD, November 2022), 43, https://assets.publishing.service.gov.uk/.

7. JDP 0-01, 43.

8. Gareth Evans, "Rethinking Military Intelligence Failure: Putting the Wheels Back on the Intelligence Cycle," *Defence Studies* 9, no. 1 (2009): 23; and John A. Gentry, "The 'Professionalization' of Intelligence Analysis: A Skeptical Perspective," *International Journal of Intelligence and CounterIntelligence* 29, no. 4 (2016): 659, https://doi.org/.

Rigor and Standards in Intelligence Analysis

The nature of analytic standards and the related concept of analytical rigor is still a matter of some debate. While analytical rigor generally refers to the thoroughness of intelligence tools and techniques employed in analysis and assessment, analytic standards refer to the broader attributes of an intelligence product that make it effective, one of which is rigor. Resolving the debate about the connection between the two is key to understanding how analytic standards apply beyond the strategic level. The first step in applying analytic standards to tactical and operational military intelligence is therefore understanding the relationship between rigor and standards in intelligence analysis.

Analytical Rigor

The general perception of analytical rigor is that it indicates reliability and thoroughness, as opposed to demonstrating inflexibility or reflecting an analyst's inability to change their point of view.[9] Such rigor is a desirable outcome for intelligence, and it is therefore no surprise that key analytic standards documents such as ODNI's Intelligence Community Directive 203 and the UK's Professional Head of Intelligence Assessment's (PHIA) "Common Analytic Standards" consider rigor central to sound intelligence analysis.[10] Beyond this fundamental concept, however, there is some disagreement on how to further characterize analytical rigor.

By one definition, analytical rigor is input-focused, that is, contained within the processes by which intelligence analysis is conducted. These processes, referred to within the United States' IC as analytical tradecraft, are designed to eliminate biases and assumptions and in turn encourage quality analysis.[11] Analytical tradecraft ranges from basic processes for interpreting intelligence collection to structured analytical techniques. These techniques, such as backcasting and analysis of competing hypotheses, increase rigor by breaking down intelligence problems, highlighting both assumptions and the basis for assessments. For some, structured analytical techniques are the bedrock of process rigor, although criticism of this approach has persisted over the years.[12]

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9. Daniel J. Zelik, Emily S. Patterson, and David D. Woods, "Understanding Rigor in Information Analysis," in *Proceedings of the Eighth International NDM* [Naturalistic Decision Making] *Conference*, ed. K. Mosier and U. Fischer (Pacific Grove, CA: NDM, June 2007): 1.

10. ICD 203, 2–4; and Professional Head of Intelligence Assessment (PHIA), *Professional Development Framework for All-Source Intelligence Assessment* (London: Joint Intelligence Organisation, January 2019), 26, https://assets.publishing.service.gov.uk/.

11. Gentry, "ODNI," 641.

12. Stephen Marrin, "Intelligence Analysis: Structured Methods or Intuition?," *American Intelligence Journal* 25, no. 1 (2007): 14, https://www.jstor.org/; Robert D. Folker Jr., "Intelligence Analysis in Theater Joint Intelligence Centers: An Experiment in Applying Structured Methods," *Occasional Paper* 7 (Washington, DC: Joint Military Intelligence College, January 2000), 8, https://irp.fas.org/; and Welton Chang et al., "Restructuring Structured Analytic Techniques in Intelligence," *Intelligence and National Security* 33, no. 3 (2018), https://doi.org/.

Even outside the realm of highly structured techniques, some believe analytic standards should be evaluated in terms of the quality of the analytical processes that contributed to an assessment, adopting the viewpoint that procedural rigor creates good intelligence analysis.[13] According to this approach, analytic standards are intrinsically linked to procedural rigor.

The other approach to characterizing analytical rigor is output-focused. This alternative viewpoint considers a wider range of attributes that contribute to rigor. Rather than focusing on the quality of the processes, it instead focuses on the quality of the finished intelligence product. For example, one 2007 study of analytical rigor introduces the concept of sufficient rigor, where analytic standards are evaluated in terms of sufficiency across multiple attributes visible in an intelligence product.[14] This approach characterizes analytical rigor primarily in terms of what is delivered to customers rather than what process is employed in analysis: this notion of sufficient product rigor ensures that intelligence analysis is translated into useful outputs.

Both approaches—process- and product-focused—differ primarily in where they place the emphasis when judging the quality of intelligence analysis. Some scholars argue these approaches are not mutually exclusive and instead describe analytic standards at two different stages of intelligence analysis. They posit that process rigor is required for effective analytic work, while product rigor is required for quality intelligence outputs.[15]

It appears that the use of the term rigor to describe the overall standard of an intelligence product creates unnecessary confusion. Studies that aim to investigate rigor frequently incorporate other attributes beyond thoroughness of analytic reasoning, suggesting rigor is not the sole measure of quality. Examples of this might include clarity of communication, auditability, and effective sourcing, or the degree to which intelligence requirements are met. This is reflected in ICD 203. In addition to defining a different relationship between standards and rigor and alongside the characteristics of process rigor, ICD 203 also includes broader attributes of an intelligence product—such as timeliness and use of visual information—as analytic standards.[16]

The separation between process rigor and wider analytic standards is more evident in the PHIA analytic standards for the UK, where rigor is identified as one of the eight components of analytic standards and is characterized by "processes, tools and techniques appropriate to the intelligence requirement in order to be able to show logical and coherent

13. Patrick F. Walsh, "Improving Strategic Intelligence Analytical Practice through Qualitative Social Research," *Intelligence and National Security* 32, no. 5 (2017): 560, https://doi.org/.

14. Daniel J. Zelik, Emily S. Patterson, and David D. Woods, "Judging Sufficiency: How Professional Intelligence Analysts Assess Analytic Rigor," in *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 51, no. 4 (October 2007): 318; and Zelik, Patterson, and Woods, "Understanding Rigor," 1.

15. Ashley Barnett et al., *Analytic Rigour in Intelligence* (Melbourne, Australia: University of Melbourne, April 2021), 14, https://cpb-ap-se2.wpmucdn.com/.

16. ICD 203, 2–4.

reasoning."[17] More recent scholarship of intelligence analysis is also beginning to conform to this viewpoint, where rigor is one part of a broader set of analytic standards.[18] Though rigor is important to sound intelligence analysis, it is but one attribute of an effective intelligence product.

The scholarly focus on analytic rigor has two causes. One is that the high-profile shocks that kickstarted modern interest in analytic standards were both failures of analytical rigor specifically. In the case of the National Intelligence Estimate for WMD in Iraq, poor rigor in strategic intelligence assessment was identified as a primary issue, which paved the way for subsequent shortfalls in independence, objectivity, and auditability.[19] The US commission report on WMDs noted an absence of common standards for analysis led to a shortfall in rigor, and pointed out that this had been identified in various earlier reports on the IC, but before the early 2000s, it had largely been ignored.[20] This criticism is echoed for the UK in the Chilcot Report, which singles out a poor standard of analytical rigor as the key contributor to intelligence failures preceding the 2003 invasion of Iraq.[21]

For 9/11, poor analytical rigor again played a defining role in the Intelligence Community's failure to predict al-Qaeda's large-scale terrorist attack in the United States.[22] The *9/11 Commission Report* stated that while techniques and processes were available for improving analytical rigor, they had not been iterated upon or applied effectively across the IC.[23] Because of the particular focus given to analytical rigor rather than other attributes of intelligence analysis in these reports, the subsequent significant academic and policy emphasis on it is perhaps unsurprising.

Yet this masks a second, more fundamental cause for the academic focus on analytical rigor. Analytical rigor received such attention in the study of strategic intelligence analysis because it is a priority for strategic-level intelligence itself. This characteristic emerges from the nature of strategic intelligence, which is to tackle the largest and most complex intelligence problems.[24] In support of strategic decision-making, such as the invasion of another country, the thoroughness of an assessment becomes the primary focus. Further, in order to be concise—to be consumable by senior decisionmakers—strategic intelligence

17. PHIA, *Professional Development Framework*, 26.

18. Barnett et al., *Analytic Rigour*, 21.

19. "The October 02 National Intelligence Estimate (NIE)," PBS Frontline, posted June 20, 2006, https://www.pbs.org/.

20. Laurence H. Silberman et al., *The Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction (WMD): Report to the President of the United States* (Washington, DC: Commission on Intelligence Capabilities Regarding WMD, 2005), 389, https://georgewbush-whitehouse.archives.gov/.

21. Iraq Inquiry, *The Report of the Iraq Inquiry: Executive Summary* (London: Her Majesty's Stationary Office, 2017), 114, https://assets.publishing.service.gov.uk/.

22. Douglas Porch and James J. Wirtz, "Surprise and Intelligence Failure," *Strategic Insights* 1, no. 7 (2002): 3–4, https://apps.dtic.mil/.

23. Thomas Kean and Lee Hamilton, *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks upon the United States*, vol. 1 (Washington, DC: Government Printing Office, 2004), 346–48.

24. Walsh, "Strategic Intelligence," 551.

products must effectively distill these broad problems, requiring structured rigor. At the most fundamental level, the focus on analytical rigor in scholarship of intelligence analysis, as well as in key analytic standards documents, is caused by the primacy of rigor above other attributes of timely, relevant, and meaningful strategic intelligence analysis.

Deconstructing analytic standards and analytical rigor has revealed several important implications for these standards in operational and tactical military intelligence. First, it recognizes the applicability of analytic standards for improving intelligence analysis. Second, it separates analytical rigor—the thoroughness of intelligence tradecraft employed in analysis and assessment—from analytic standards, or the broader attributes of an intelligence product that make it effective. Third, it demonstrates that the specific characteristics of strategic intelligence analysis mean that some analytic standards—in this case, rigor—are of greater importance in strategic analysis.

This suggests that at the tactical and operational levels of warfare there may also be different characteristics that lead to different priorities for analytic standards. To identify how analytic standards apply beyond the strategic level, a greater understanding of military intelligence analyses in these environments is required.

Tactical and Operational Intelligence Analysis

Military intelligence draws from procedural and disciplinary elements of both intelligence organizations and armed services.[25] In common with civilian intelligence agencies, military intelligence performs a range of functions which are often represented in an intelligence cycle. The debate regarding the merits and utility of the intelligence cycle would fill an entire article of its own; however, for the purpose of this article the broad categories it defines—direction, collection, processing, analysis, and dissemination—are useful in thinking about core intelligence activities.[26] Though intelligence activities in the United States and the United Kingdom encompass all of these stages, analytic standards chiefly concern the analysis stage. Examining this part of military intelligence work will identify how the assumptions of mainly strategic analytic standards may change in tactical and operational environments.

Tactical Intelligence

At the tactical level, military intelligence analysis has several distinguishing characteristics. For one, intelligence analysis teams are often much smaller than they are in

25. Jack Duffield, "Military Intelligence as a Dual Professional Identity: A Response to 'Military–Intelligence Relations: Explaining the Oxymoron,'" letter to the editor, *International Journal of Intelligence and CounterIntelligence*, published online January 3, 2024, 2, https://doi.org/.

26. Michael Warner, "The Past and Future of the Intelligence Cycle," in *Understanding the Intelligence Cycle*, 1st ed., ed. Mark Phythian (London: Routledge, 2013), 17–19, https://doi.org/.

strategic environments.[27] This is not only an inevitable consequence of deployed operations, where the number of personnel placed in harm's way must be as small as possible, but it is also a fact of scale. Across multiple units, each potentially with taxing deployment schedules and shift patterns, even a large number of analysts are quickly spread thin. Intelligence analysts below the strategic level are also often reporting to a small customer base, such as operational commanders and other units with overlapping areas of intelligence interest.[28] In many cases, tactical intelligence analysts will be directly subordinate to their principal customer, who strongly influences priorities for intelligence output.

Moreover, in this environment, intelligence analysis must be highly focused. Operational relevance becomes vital, and intelligence assessments are often tailored to the unit being supported.[29] Analysts are further required to be familiar with the capabilities they are supporting. To triage incoming reporting and make useful assessments, intelligence analysts must understand operating environments, friendly defensive capabilities, likely missions and potential operating areas, as well as the assumptions underpinning risk decisions.

A final distinguishing characteristic of tactical intelligence analysis is the short timescales involved. A full cycle of planning and execution can occur in fewer than 24 hours, and military capabilities are consistently held at the shortest possible readiness level, measured in hours or even minutes.[30] Providing intelligence analysis inside these narrow time frames is atypical for strategic intelligence analysts, who are not usually expected to deliver finished products in response to near real-time requirements outside of crisis scenarios.[31] Even beyond the deployed environment, large-scale deep dives into intelligence problems are rarely the most effective use of a tactical analyst's time. A broad understanding of the strategic picture is generally sufficient to contextualize tactical intelligence work.

Operational Intelligence

For operational-level intelligence analysis, many of the same principles apply, but to a lesser extent. This is understandable, given that the operational level of warfare is doctrinally a midpoint between tactical and strategic levels of warfare. Intriguingly, a recent study has questioned the very existence of the operational level of warfare; however, as it remains an accepted and central component of current Western military doctrine and organizations, the operational level of warfare certainly merits exploration in its own right.[32]

27. Phillip Surrey, "Air Mobility Intelligence: Survivability in the Contested Environment," *Air and Space Operations Review* 1, no. 3 (2022): 39, https://www.airuniversity.af.edu/.

28. Evans, "Rethinking," 30; and MOD, *Intelligence, Counter-Intelligence and Security Support to Joint Operations,* JDP 2-00 (Bristol, UK: MOD, August 2023), 172, https://assets.publishing.service.gov.uk/.

29. Surrey, "Air Mobility Intelligence," 44.

30. Defence Select Committee, Memorandum by the Ministry of Defence, The Defence White Paper, Readiness Assumptions, www.parliament.uk, April 2004, https://publications.parliament.uk/.

31. Evans, "Rethinking," 28–29.

32. Brett Friedman, *On Operations: Operational Art and Military Disciplines* (Annapolis, MD: Naval Institute Press, 2021).

The operational intelligence environment also introduces unique further considerations beyond those expected of the conceptual midpoint between the tactical and strategic levels where operations traditionally are understood to occur. First, supported capabilities are less important, as operational-level headquarters become more platform-agnostic to command multi-asset and multidomain operations.[33] In the place of capability knowledge, a comprehensive understanding of the area of operations and the adversaries working within it become paramount. Tactical analysts, narrowly focused on producing intelligence to shape execution in their specific area, are expected to collaborate with their operational-level counterparts to resolve gaps in their wider understanding.[34] Operational-level analysts therefore also become vital for communicating key information across intelligence chains with absolute clarity, as well as tracking the sources of this information.

Given their role directly supporting operational commanders, intelligence teams at the operational level often form a red cell, which challenges assumptions and bias in operational plans and seeks to understand how adversary and other forces might think and behave differently.[35] Operational-level intelligence analysts are frequently both a focal point and a regional authority in military intelligence analyses, creating a bottleneck in intelligence chains, which makes impartiality a priority. Operational-level analysts must stand apart from the collective mindset and perspective of their unit when performing their duties, to preserve the capability to challenge groupthink and thus insure against intelligence failure. Accordingly, the operational intelligence environment has its own unique considerations—belying the understanding of operations as a midpoint between strategy and tactics—which challenge the assumptions of analytic standards applied at the strategic level.

Differences from Strategic Intelligence

These two subdisciplines of intelligence analysis contrast starkly with strategic analysis. Military intelligence analysts who work at the strategic level often bring their specific military expertise to broader strategic problems, both military strategic and grand strategic in nature. The characteristics of military strategic intelligence are perhaps the least distinctive from civilian intelligence analysis: analytical teams in both settings focus on longer-term analyses, and the more generalized areas of concentration make deep thematic specialization practical.

As discussed above, systematic approaches such as structured analytical techniques also become more relevant, and less dynamic requirements mean that a greater level of process rigor can be applied.[36] More generally, the less time-sensitive intelligence questions posed to strategic analysts result in longer and more comprehensive products for national-level

33. JDP 0-01, 23.

34. Secretary of the Air Force (SecAF), *Intelligence Analysis*, Air Force Instruction (AFI) 14-33 (Washington, DC: Department of the Air Force, March 29, 2016), 13, https://irp.fas.org/.

35. JDP 2-00, 163.

36. Walsh, "Strategic Intelligence," 560.

decisionmakers, who typically do not demand highly specific reporting with only days or hours of intelligence value.

Intelligence questions at the strategic level are also broader and more nebulous. Whereas a tactical analyst often deals with a bounded problem set with a single capability in a defined geographic area, strategic military intelligence analysts may be responsible for countries or even whole continents. Given these broad remits, larger parts of the Intelligence Community can become more relevant; for the United States alone, the full IC is estimated to employ more than 800,000 people.[37] Importantly, the wider range of reporting available for strategic intelligence analysis at this level and increased use of fused intelligence products greatly heighten the risk of circular reporting if sourcing chains are not clear, reinforcing the need for a level of rigor that is not applicable at the tactical and operational levels.

Finally, for the UK, some characteristics of tactical intelligence analysis, such as knowledge of friendly capabilities, become effectively irrelevant for strategic military intelligence, shaping operational priorities but making little impact on analytical output.

Analytic Standards

Analytic standards are applied differently in each of these environments. Far from being environments with less rigorous analytic standards, the tactical and operational levels instead value different attributes of intelligence analysis more strongly, as in the case of strategic intelligence where rigor is key. As noted in a University of Melbourne study, good analysts will generally seek to meet the highest standard feasible in their circumstances.[38] Nonetheless, the different levels of intelligence analyses introduce differences in focus for analytic standards. Figure 1 represents this varied prioritization of analytic standards at the tactical, operational, and strategic levels, conveying visually the relevant importance of each standard based on the analysis above.

37. J. Tucker Rojas, *Masters of Analytical Tradecraft: Certifying the Standards and Analytic Rigor of Intelligence Products*, Wright Flyer Papers (Maxwell AFB, AL: Air University Press, May 2019), 2, https://media.defense.gov/.

38. Barnett et al., *Analytic Rigour*, 14.

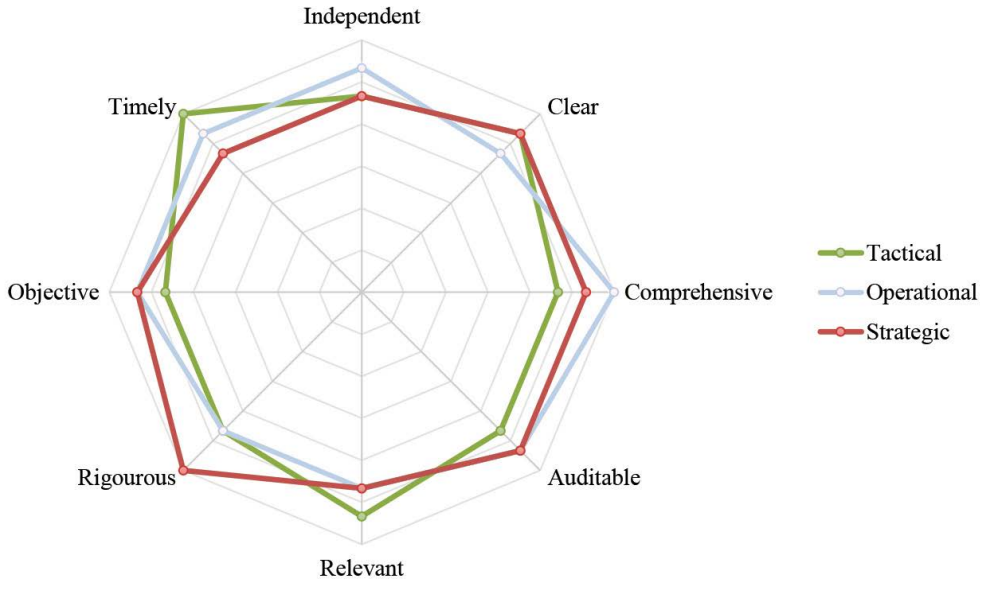

Figure 1. Visual illustration of the relative importance of analytic standards in different military intelligence environments, based upon the PHIA analytic standards framework

Though the figure is illustrative and does not offer a quantitative breakdown of the relative importance of each standard, it does recognize that analytic standards in general are of significant importance to intelligence output at every level. It also highlights that a one-size-fits-all approach to analytic standards is insufficient for the full range of military intelligence environments. In particular, the focus on rigor in key intelligence standards documents largely favors the strategic intelligence environment, at the expense of applicability to the tactical and operational levels. With an understanding of both analytic standards in general and the nature of intelligence analysis in the military, it is now possible to determine fully how analytic standards apply differently in the context of military intelligence.

Applying Analytic Standards Appropriately

There are many variations in the application of analytic standards in different military intelligence environments. For example, while thorough sourcing chains are considered essential at the strategic level, they can be omitted at the tactical level, providing the analyst has a sound understanding of where their key information has come from.[39] Both written sourcing chains and individual analysts' subject matter expertise are appropriate

39. Timothy Haugh and Douglas Leonard, "Improving Outcomes: Intelligence, Surveillance, and Reconnaissance Assessment," *Air & Space Power Journal* 31, no. 4 (2017): 10, https://www.airuniversity.af.edu/.

in the context of the activity that they support, but neither would be a good fit for the other environment. This is only one example of how the characteristics of intelligence analysis at different levels of war manifest in differing requirements to meet the same analytic standard. Military intelligence outputs therefore require analytic standards tailored to and appropriate for each military intelligence environment.

For example, the US Air Force has published supplemental analytic standards for intelligence in Air Force Instruction (AFI) 14-133, *Intelligence Analysis*. This document recognizes the primacy of ICD 203 in Air Force intelligence analyses, but it tailors analytic standards and tradecraft standards to US Air Force operations. Importantly, AFI 14-133 adjusts the IC tradecraft standards, which are referred to as Air Force intelligence analysis standards. While ICD 203 refers to timeliness in a general sense of "useful analysis at the right time," AFI 14-133 specifies that it must be achieved with respect to mission planning cycles, recognizing that timeliness may be constrained to just a few hours in some environments. Similarly, while ICD 203 insists intelligence products must be "based on all available sources," AFI 14-133 qualifies this by noting that sources should be cited "when feasible" and by dropping the requirement for comprehensive coverage in all cases.[40]

The US Air Force analytic standards more closely resemble the UK's analytic standards, fused with other elements to create a practical checklist for effective analysis.[41] Amendments such as these in the Air Force analytic standards take better account of how intelligence is practically employed in military operations, adapting to the idiosyncrasies of military intelligence environments.

AFI 14-133 also introduces intelligence analysis tenets—more akin to principles than standards—that "cover the most important beliefs about [US Air Force] intelligence analysis" and how ICD 203 should be applied in support of these beliefs.[42]

Environment-specific standards for military intelligence such as those in AFI 14-133—further subdivided into specific guidance for product types such as premission briefs, intelligence scenarios, and update briefs, or presented as more general principles—offer a valuable resource for measuring the quality of intelligence products. As one scholar argues, analytic standards are primarily useful to "raise the floor" of acceptable intelligence output and have less utility for judging high-quality products.[43] It is therefore acceptable for analytic standards in military intelligence to be prescriptive, stating specifically whether certain features such as sourcing, structured analytical techniques, and probabilistic language are required, recommended, or suggested in each environment.

The most interesting feature of US Air Force analytic standards is the recognition of differing modes of intelligence analysis in different situations. The Air Force identifies a continuum of intelligence analysis. At one end, traditional "all-source analysis" prioritizes thorough analysis of a wide range of sources, applying analytical techniques and deep

40. ICD 203, 3; and SecAF, AFI 14-133, 14.
41. SecAF, 14–17.
42. SecAF, 13.
43. Gentry, "ODNI," 645.

expertise to produce detailed and broad products.[44] At the other end is an alternative approach referred to as "fusion analysis," which is described as "quickly melding new information with baseline knowledge to meet specific operational needs."[45] This concept of fusion analysis describes tactical intelligence analysis in several key ways, such as emphasizing rapidity and the use of a smaller number of focused intelligence sources to answer intelligence requirements for an operational customer. It also suggests that in these time-sensitive situations, an analyst's baseline knowledge is an acceptable substitute for fully audited and referenced products.

Although UK analytic standards do not formally recognize fusion analysis, it is an everyday reality of working in any Western intelligence organization, where phone calls to regional analysts or teams to corroborate or request information—or even to develop an ad hoc assessment—are commonplace. In some cases, such calls are used to focus analytical efforts or generate alternative hypotheses in support of intelligence products. In other cases, a rapid succession of calls, emails, or chats may be the only way to deliver effective intelligence updates in an acceptable timescale should the threat to operations change rapidly, perhaps even during the course of a mission. Fusion analysis in intelligence is thus a valuable doctrinal concept that demonstrates a successful application of the principles of analytic standards in a tactical military intelligence environment.

Interestingly, AFI 14-133, as noted above, offers the construct of a continuum to recognize that analytic standards do not apply uniformly to all analyses. Yet it does not delineate the difference between all-source and fusion analysis within a tactical-strategic paradigm. Instead, AFI 14-133 acknowledges analysts will operate somewhere between fusion analysis and all-source analysis at different times, often depending on time, the availability of information sources, and customer requirements. In fact, the primary delineation between these techniques is the extent to which the analyst may rely upon their own current knowledge of intelligence reporting and general atmospherics in their area of responsibility. In this way, this analytic continuum distinguishes between analysis conducted with a high degree of preexisting subject knowledge and analysis conducted without it, irrespective of the analytic standards applied.

One study on the Central Intelligence Agency's (CIA) analyst training program distinguishes three types of expertise in intelligence: regional expertise in a specific area, disciplinary expertise in the general skills of analysis, and procedural expertise in the methods and processes of intelligence delivery, especially review processes.[46] Using this model, regional expertise—analogous to subject matter expertise in intelligence disciplines that are not geographically constrained—is the type of expertise recognized by the Air Force as suitable in some intelligence applications across all levels of operations. The analyst as a source is a reality of intelligence analysis, particularly in intelligence environments where analytical

44. SecAF, AFI 14-133, 4.

45. SecAF, 4.

46. Stephen Marrin, "CIA's Kent School: Improving Training for New Analysts," *International Journal of Intelligence and CounterIntelligence* 16, no. 4 (October 2003): 613, https://doi.org/.

power is constrained by size. Reconciling subject matter expertise with analytic standards is the final step in understanding how such standards apply to military intelligence.

Accrediting the Analyst

The huge number of potential tactical- and operational-level operating environments means military intelligence analysts may be thinly spread across multiple theaters and deployments. As well as the simple matter of size, there are other factors that might constrain the number of intelligence analysts working on a given intelligence problem. These factors are especially relevant beyond the strategic level, where deployments and shifts are the norm.

In deployed operations, there is an incentive to put the minimum number of people in harm's way where there is a greater risk of injury or death as a result of enemy action. Adding to this is what the UK government refers to as the "burden" of operational deployments. These deployments disrupt the lives of service personnel and are therefore minimized where practical.[47] When the operations tempo is high, personnel also require periods of rest, leave, and training before returning to deployed operations—or periods of intense operational activity at home—meaning that large proportions of personnel cannot be deployed simultaneously without compromising the long-term ability to replace them.

Though these constraints may not apply all at once in every scenario, they must be considered to ensure military intelligence capabilities are sufficiently agile and resilient. These constraints increase the importance of individual analysts with a high degree of subject knowledge who can dramatically reduce the time required to deliver intelligence output. In some cases, this could be a single analyst on shift in a tactical environment, with limited communications capability and little ability to reach back to experts who can answer ad hoc questions posed by those deployed forward.[48]

The delivery of intelligence products by a small team of analysts, perhaps even a single analyst, conflicts with the guidance of scholars of strategic intelligence analysis. Scholars refer to the effective use of teams of analysts as "team cognition," which improves the ability of analysts to develop solutions to complex intelligence problems.[49] Multiple analysts can refine hypotheses, widen the research base for a product, and propose alternative analytical approaches and product presentations to improve the overall standard of a product.

Senior analysts in particular play a pivotal role in enforcing analytic standards. Through quality control chains, more senior personnel review their subordinates' work to identify logical shortfalls or gaps in reasoning before a product is disseminated. One study observed

47. MOD and Rt Hon Philip Hammond, "Afghanistan Tour Lengths for Deployed UK Personnel," GOV.UK, May 14, 2023, https://www.gov.uk/.

48. Surrey, "Air Mobility Intelligence," 39.

49. Stoney Trent, Martin Voshell, and Emily Patterson, "Team Cognition in Intelligence Analysis," *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 51, no. 4 (October 2007): 308, https://doi.org/.

that a reliable standard of analytical quality control required at least three different analysts to "rate" the quality of an intelligence product, meaning that optimized intelligence products require at least four analysts in total to deliver.[50] For the reasons discussed above, this is sometimes impractical in intelligence environments other than the strategic level. In short, an alternative to multi-analyst quality control is required for tactical and operational military intelligence environments.

The concept of analytical tradecraft is defined in ICD 203 and revisited in AFI 14-133 as a core feature of intelligence analysis, emphasizing the role of the individual analyst in implementing analytic standards.[51] As mentioned, analytical tradecraft refers to the individual skills of an analyst—the disciplinary expertise in the general skills of analysis and the procedural expertise in the methods and processes of intelligence delivery as defined by the CIA training study.[52] Accreditation of these core analytical skills is an essential component of analytic standards, although for states such as the UK, this is measured in terms of an ability to deliver products which meet standards rather than as attributes in their own right.

A viable approach is to accredit the analytic tradecraft of analysts themselves. This is the approach proposed by one researcher who argues the United States needs analysts accredited to a high standard of disciplinary and procedural intelligence expertise who could take leading roles in improving the quality of intelligence products.[53] This approach has echoes of the Qualified Weapons Instructor program in the UK—similar to the US Air Force's Weapons School program or the US Naval Aviation Warfighting Development Center program—which emphasizes extensive training of selected personnel to reach a high standard of individual output, and in turn accredits them to teach these skills to others.

These programs align with the intent of AFI 14-133 and the general direction of ICD 203, where analyst training is recognized as a means of improving the overall standard of intelligence products. While capstone training, such as Qualified Weapons Instructor courses, develops a small number of already capable analysts, current analytic standards for all levels of military intelligence also apply much more broadly, serving a complementary function in enhancing the quality of all military intelligence analysts.

Furthermore, the requirement for military intelligence analysts to be prepared to work in very small teams means that accreditation cannot be limited to products alone. Instead, analytic standards tailored to the different military intelligence environments must be applied to accredit the analyst and their expertise in their role. The AFI 14-133 tradecraft standards offer an example of how this can be achieved, bridging the gap between capstone accreditation of a small number of expert analysts and the demands of intelligence environments beyond the strategic level.

50. Marcoci et al., "Better Together," 1.
51. ICD 203, 2–4; and SecAF, AFI 14-133, 14–17.
52. Marrin, "CIA's Kent School," 613.
53. Rojas, *Masters*, 11.

Conclusions

Analytic standards are essential to high-quality military intelligence output across all levels of war. Yet scholarship of analytic standards is currently based on the strategic intelligence environment, with a high emphasis on rigor. Meanwhile, tactical intelligence environments value other attributes of analytic standards, such as timeliness, to a far greater extent than in strategic environments, and must apply these standards in different ways. The operational environment, far from being a midpoint between the tactical and strategic environments, has attributes all its own, prioritizing comprehensiveness and independence over other attributes.

Military intelligence environments therefore require analytic standards to be adapted differently, to resolve the rigor-led, strategic bias inherent to traditional analytic standards. The US Air Force's AFI 14-133 demonstrates how analytic standards can be applied to separate military intelligence environments, particularly in how it shifts focus toward the analyst and their output as emblematic of an ideal product. Recognizing the importance of accrediting the analyst is key to implementing effective analytic standards in military intelligence environments. Exploring how analytic standards are used in military intelligence lays the foundation for further progress in a vital but understudied area of intelligence scholarship.

Operational Art:

A Necessary Framework for Modern Military Planning

Jonathan K. Corrado

In today's wars and future conflicts, military leaders will face a wide variety of complex threats. They must be capable of addressing these threats in the context of Joint and multinational operations, and they must have the vision to understand how best to apply assets in a manner that will ultimately achieve US national policy aims. In short, leaders must employ operational art. A key question to ask is whether the United States—now that it has shifted its focus toward great power competition in an increasingly multipolar world—retains sufficient aptitude in operational art. A review of the history and development of operational art, as well as an assessment of its importance in a modern context, serves as a reminder of the nature and continuing relevance of operational art in a changing world. This article focuses on deriving classic lessons from operational art that will be relevant to American military planning vis-à-vis Russia, China, and smaller national and nonstate enemies in a counterinsurgency context.

Current theory defines operational art and planning as a process that allows for an efficient distribution of combined forces in ways that will achieve desired outcomes. According to Joint Publication (JP) 3-0, *Joint Campaigns and Operations*, operational art represents "the cognitive approach by commanders and staffs—supported by their skill, knowledge, experience, creativity, and judgment—to develop strategies, campaigns, and operations to organize and employ military forces by integrating ends, ways, and means."[1]

Current interpretations of operational art additionally emphasize its role in linking diverse units and forces together as a means of achieving key objectives through reliance on combined force.[2] Joint Publication 5-0, *Joint Planning* states "operational art and operationaldesign enable understanding, provide context for decision making, and enable commanders and planners to identify hazards, threats, consequences, opportunities, and risk."[3] Although such interpretations represent established ideas and frameworks that military decisionmakers apply within their dimensions of operational planning, they also reflect ideas that have evolved over time.

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1. *Joint Campaigns and Operations*, Joint Publication (JP) 3-0 (Washington, DC: Chairman of the Joint Chiefs of Staff [CJCS], June 18, 2022), xiii.

2. Chad Buckel, "A New Look at Operational Art: How We View War Dictates How We Fight It," *Joint Force Quarterly* 100 (2021).

3. *Joint Planning*, JP 5-0 (Washington, DC: CJCS, December 1, 2020), xi.

A historical review of the evolution of operational art offers an evaluation of the theory's origins to demonstrate how the ideas underlying operational art derive from the foundation of modern warfare and military planning and how the concept matured and evolved. Assessments of the theory's impact on the US military experience show how it has shaped America's approach to operations at the service and Joint levels. This article ultimately demonstrates the relevance of operational art with respect to American planning as it relates to Russia, China, and counterinsurgency (COIN).

Operational Art and Planning: Historical Development and Evolution

> *In forming the plan of a campaign, it is requisite to foresee everything the enemy may do, and be prepared with the necessary means to counteract it. Plans of the campaign may be modified ad infinitum according to the circumstances, the genius of the general, the character of the troops, and the features of the country.*
>
> Napoleon[4]

The French and Prussian traditions of operational art not only inform the history, but also current practice and definition of operational art. Napoleon Bonaparte's restructuring of the French army into corps—semi-independent bodies with their own infantry, cavalry, and artillery—allowed for greater operational flexibility and is a direct antecedent to modern combined arms and joint warfare concepts present in today's operational art.[5] This restructuring made the army more adaptable, able to execute complex maneuvers, and capable of responding to dynamic battlefield situations.

The Napoleonic method, especially during his early campaigns, exemplified the synchronization of efforts across the battlefield. Using a combination of speed, mass, and the interior lines of communication, Napoleon could concentrate his forces rapidly to achieve a decisive advantage. This notion of synchronized operations for achieving a higher operational tempo remains a fundamental aspect of current operational art.[6] Although attributed more to Soviet military theory, the roots of the "deep battle" concept—targeting the entirety of the enemy's forces rather than just the forward units—can be traced back to the French emphasis on strategic depth during Napoleon's time.[7] This has evolved and is reflected in contemporary definitions of operational art, emphasizing depth and simultaneity of operations.

Helmuth von Moltke the Elder, the chief of the German General Staff from 1857 to 1888, is often credited with developing the idea of allowing commanders significant

4. *The Military Maxims of Napoleon*, ed. William E. Cairnes (New York: Simon and Schuster, 2016), 56.

5. Frederick R. Strain, "The New Joint Warfare," *Joint Forces Quarterly* 2 (1993).

6. Christopher Bellamy, *The Evolution of Modern Land Warfare: Theory and Practice* (New York: Routledge, 2015).

7. Frederick W. Kagan, "The Rise and Fall of Soviet Operational Art, 1917–1941," in *The Military History of the Soviet Union*, ed. Robin Higham and Frederick W. Kagan (New York: Springer, 2002).

"operational freedom."[8] This emphasized flexibility and adaptability, concepts central to contemporary operational art. The Prussian General Staff system, which focused on meticulous planning, staff wargaming, and continuous officer education, instilled a sense of operational planning that is still recognized today.

Modern operational art reflects this in the importance placed on detailed planning and coordination across various forces. The Prussian tradition also emphasized *Auftragstaktik*, or mission-type tactics.[9] This decentralized decision-making approach, where lower-level commanders were given a clear understanding of the commander's intent and the freedom to achieve that intent as they saw fit, has been integrated into modern operational art as a means of fostering initiative and responsiveness.[10]

Over time, especially during the World Wars, military thinkers and practitioners synthesized elements from both the Prussian and French traditions. The World Wars saw an unprecedented scale and complexity of military operations, necessitating an evolved understanding of operational art that drew from both traditions. Modern doctrines, particularly in the West, reflect a blend of these traditions. For instance, the US military's emphasis on Joint operations, combined arms warfare, decentralized execution—akin to *Auftragstaktik*—and operational synchronization all bear marks of this historical legacy.[11]

In essence, while operational art as a formally recognized concept might be relatively modern, its roots in the practices of Prussian and French military traditions are evident. The successes and failures of these historical practices have directly informed the way operational art is understood and practiced today.

Operational Art and Planning: Connections to Technology

The evolution and maturation of operational art, rooted in the traditions of Prussia and France but now impacting all nations, has been deeply influenced by the concurrent evolution of technology and is a tale of adaptation and reinvention. Historically, every significant advancement in technology has challenged existing military doctrines, forcing strategists and tacticians to rethink how wars are fought. At times, these shifts might make it seem as if operational art is becoming obsolete; but, in truth, it is continually evolving to incorporate these new elements.

The French Revolutionary and Napoleonic eras saw the advent of mass conscription, transforming armies from small professional entities to large bodies of citizen soldiers. This, combined with advancements in artillery technology, allowed Napoleon to leverage massed

8. Richard Davis, "Helmuth von Moltke and the Prussian-German Development of a Decentralised Style of Command: Metz and Sedan 1870," *Defence Studies* 5, no. 1 (2005).

9. Eitan Shamir, "The Long and Winding Road: The US Army Managerial Approach to Command and the Adoption of Mission Command (*Auftragstaktik*)," *Journal of Strategic Studies* 33, no. 5 (2010).

10. Michael J. Gunther, *Auftragstaktik: The Basis for Modern Military Command* (New York: Pickle Partners Publishing, 2015).

11. Shamir, "Winding Road."

firepower and maneuver in new ways, adapting the corps system effectively to the technological realities of his era. The use of visual signaling systems, such as the semaphore, played a role in coordinating and synchronizing Napoleonic operations across vast distances.[12]

After the Napoleonic era, the meticulous planning and coordination associated with the Prussian General Staff system were heavily facilitated by the advent of the railway and telegraph systems in the nineteenth century. These technologies enabled rapid mobilization and communication, allowing von Moltke to execute wide-ranging operations with greater synchronization.[13] Operational art adapted as technological advancements in artillery, specifically the ability to conduct indirect fire, required a more detailed level of operational planning, coordination, and reconnaissance—all hallmarks of the Prussian tradition.[14]

The stalemated battlefields of World War I were a direct result of technological advancements—notably, machine guns and barbed wire—outpacing tactical and operational thought. The challenge of overcoming static defensive lines led to further evolution in operational art, emphasizing combined arms operations, especially the integration of infantry, artillery, and the nascent air forces.[15] Operational art matured by reemphasizing maneuver, albeit in a different context.

In World War II, the combination of motorized/mechanized units and radio communications allowed for more fluid and dynamic operations. Tanks, supported by aircraft and effectively communicated with via radio, allowed for deep penetrations into enemy territory. Some thought traditional principles of warfare, deeply rooted in horse-and-musket-era thinking, were now irrelevant. This confluence of technology and doctrine is exemplified in the German concept of blitzkrieg, which bears both Prussian and French influences—a modern manifestation of older principles such as surprise, concentration, and maneuver.[16] Post-World War II, the advent of nuclear weapons and electronic warfare equipment necessitated a new dimension in operational art, focusing on deterrence, rapid response, and electronic countermeasures. This era also saw the importance of operational security and deception reach new heights.

In the modern era, the digital revolution, cyber warfare, precision-guided munitions, space-based assets, and drones are once again reshaping operational art.[17] The foundational principles derived from the Prussian and French traditions—including flexibility, synchronization, and combined arms operations—remain crucial. Yet they are continually adapted

12. Helena Rua, Alexandre B. Gonçalves, and Ricardo Figueiredo, "Assessment of the Lines of Torres Vedras Defensive System with Visibility Analysis," *Journal of Archaeological Science* 40, no. 4 (2013).

13. Davis, "von Moltke"; and Gunther E. Rothenberg, *The Art of Warfare in the Age of Napoleon* (Bloomington: Indiana University Press, 1980).

14. William Walworth, "Can Enduring Lessons Be Drawn from Previous Eras? Discuss with Reference to the Franco-Prussian Campaigns of 1870," *Defence Studies* 3, no. 1 (2003).

15. Richard W. Harrison, *The Russian Way of War: Operational Art, 1904–1940* (Topeka: University Press of Kansas, 2001).

16. James S. Corum, *The Roots of Blitzkrieg: Hans von Seeckt and German Military Reform* (Topeka: University Press of Kansas, 1992).

17. Daniel Byman, "Why Drones Work," *Foreign Affairs* 92 (2013).

to address the challenges and opportunities presented by new technologies. In essence, as technology evolves, so does operational art, always striving to best leverage the tools at hand to achieve strategic objectives.[18]

As the US military's involvement in the Global War on Terror highlighted, a technologically superior force can still find itself challenged by asymmetric threats and guerrilla warfare.[19] Operational art is crucial in adapting traditional doctrines to counterinsurgency, urban warfare, and nation-building missions.[20] While technological advancements periodically challenge the relevancy of operational art, they never render it obsolete. Instead, they drive its evolution. Operational art remains a necessary framework for understanding and applying military force, ensuring that technology serves strategy, rather than dictating it. The underlying principles of operational art—such as coordination, concentration, and adaptation—are timeless, even as the tools of warfare change.

Operational Art in Past US Military Contexts

The United States, as part of the Allied forces, applied the principles of operational art in major offensives such as Operation Overlord, the D-Day invasion. The integration of sea, air, and land components; the synchronization of efforts; and the maneuvering of vast armies across Europe epitomized operational art.[21] In the Pacific Theater, island-hopping campaigns demonstrated the United States' grasp of operational depth and sequencing.[22] The US Navy and Marine Corps had to seize, hold, and use a series of islands as stepping stones toward the Japanese mainland, each with its own set of challenges and objectives.

The initial stages of the Korean War saw a rapid North Korean advance. Yet the Inchon Landing, masterminded by General Douglas MacArthur, showcased operational maneuvers, catching North Korea by surprise and reversing the course of the war.[23] Later stages, particularly after China's intervention, saw a shift in operational focus, with an emphasis on holding ground and positional warfare.

A controversial chapter in US military history, the Vietnam War, posed challenges to the application of operational art. The United States had clear tactical successes—such as in the Ia Drang Valley—but struggled with operational and strategic alignment.[24] The

18. Shamir, "Winding Road."

19. Zalmay Khalilzad, "Afghanistan & Iraq: Lessons from Afghanistan and Iraq," *Journal of Democracy* 21, no. 3 (2010).

20. Khalilzad.

21. Francis Mackay, *Overture to Overlord: The Preparations of D-Day* (New York: Pen and Sword, 2005).

22. John T. Hanley, "Creating the 1980s Maritime Strategy and Implications for Today," *Naval War College Review* 67, no. 2 (2014).

23. Robert D. Heinl, "From Our May 1967 Issue: The Inchon Landing: A Case Study in Amphibious Planning," *Naval War College Review* 51, no. 2 (1998).

24. Peter J. Schifferle, *The Ia Drang Campaign 1965: A Successful Operational Campaign or Mere Tactical Failure?* (New York: Pickle Partners Publishing, 2015).

enemy's guerrilla tactics, the political constraints, and the difficulties of fighting in the dense terrains of Vietnam often made traditional operational planning challenging.

Though not a "hot" war, the Cold War period saw the United States engage in extensive operational planning, particularly in Europe, where the possibility of a Soviet invasion was a constant concern. Operational art was reflected in the development of plans to rapidly reinforce Europe, conduct deep strikes into advancing Soviet columns, and employ nuclear weapons as deterrence and, if necessary, in warfare.[25]

Next, Operation Desert Storm showcased the United States' first application of operational art in conflict following the Cold War. The United States executed a vast enveloping maneuver, combining airpower, ground forces, and deception operations that decimated the Iraqi Army in a matter of weeks.[26] In Iraq and Afghanistan, the initial stages of both wars saw rapid US victories, but the subsequent counterinsurgency campaigns posed challenges.[27] While the US military showed tactical proficiency, there were criticisms regarding the alignment of operational objectives with strategic goals. The complexities of nation-building, tribal dynamics, and the insurgent nature of the enemy made operational art application intricate.

There is an argument to be made that during the Global War on Terror, the US military's emphasis on counterterrorism and counterinsurgency operations led to a de-emphasis on traditional operational art. Battles were often about hearts and minds, about building local alliances, and about nuanced political and cultural dynamics as much as they were about defeating enemy forces.[28] This shift in focus could have led to atrophy in large-scale, traditional operational planning.

Arguably, operational art remains an essential tool in military planning. Yet its application and emphasis can shift based on the nature of the conflict and the adversaries involved. While counterinsurgency might downplay certain elements of operational art, conventional warfare against near-peer adversaries—as seen in the increasing focus on great power competition—brings operational art back into the spotlight. Its importance might ebb and flow based on contemporary challenges, but it remains a crucial aspect of military thinking.

Operational Art and Future Foes

Russia: Universal Themes and Historical Value

Operational art, as a military philosophy, has its roots in synthesizing strategic goals with tactical actions, ensuring that each tactical engagement serves a broader strategic

25. Stephen Biddle, "Strategy in War," *PS: Political Science & Politics* 40, no. 3 (2007).

26. Frank N. Schubert, *The Whirlwind War: The United States Army in Operations Desert Shield and Desert Storm* (Washington, DC: Government Printing Office, 1995).

27. Khalilzad, "Afghanistan."

28. Khalilzad.

purpose. This nexus of strategy and tactics is as evident today as it has ever been, especially in the context of Russia.

Historically, figures such as Carl von Clausewitz emphasized the importance of understanding warfare's center of gravity and ensuring actions taken on the battlefield led to decisive outcomes. As previously discussed, the Prussian and later German military systems, for instance, placed significant emphasis on operational maneuver, epitomized by concepts such as the Schlieffen Plan in World War I and the blitzkrieg in World War II. These operational plans were not just about achieving tactical victories but about using those victories to achieve strategic outcomes: encircling enemy armies, capturing critical resources, or rapidly advancing to force a political decision.

Russian military thought, inspired in part by its historical experiences with the likes of Napoleon and the Eastern Front of World War II, evolved its own brand of operational art. Concepts like the aforementioned deep battle emerged, emphasizing simultaneous attack across the depth of the enemy's formation, combining political, informational, and kinetic means.[29] This heritage still influences Russian military operations today.[30] The annexation of Crimea and Russia's war in Ukraine has showcased a blend of traditional force, political manipulation, information warfare, and irregular militia operations—a modern reflection of deep battle in the hybrid warfare age.[31]

The vast expanse of the Russian landmass, combined with its myriad of potential frontlines—from the Baltics to Central Asia—demands a detailed operational approach. The concept of operational depth becomes even more crucial, given the potential for multifront conflicts and the historical invasions Russia has faced, from Napoleon to Hitler.

Russia's actions in Crimea and Ukraine have revealed Russia's emphasis on integrating nonkinetic means into its operational art.[32] This includes leveraging information warfare, cyber capabilities, and "little green men" (unmarked soldiers) to achieve objectives even without conventional warfare. The application of operational art here involves synchronizing these unconventional assets with traditional military might.

On the defensive side, Russia's development of anti-access/area-denial capabilities in places like Kaliningrad or the Black Sea aims to deter or delay Western intervention, shaping the operational space to Russia's advantage.[33] Operational art in this context would require NATO planners to find ways to neutralize, bypass, or even turn these capabilities to their own advantage.

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29. Ronald Ti and Christopher Kinsey, "Lessons from the Russo-Ukrainian Conflict," *Defence Studies* 23, no. 3 (2023).

30. Ben Sohl, "Discolored Revolutions: Information Warfare in Russia's Grand Strategy," *Washington Quarterly* 45, no. 1 (2022).

31. Ti and Kinsey, "Lessons."

32. Ti and Kinsey.

33. Stephan Frühling and Guillaume Lasconjarias, "NATO, A2/AD and the Kaliningrad Challenge," in *Survival*, ed. Stephan Frühling and Guillaume Lasconjarias (New York: Routledge, 2023).

Operational art, in its essence, remains the mastery of synchronizing various elements of national power and military capabilities to achieve a strategic goal. The challenges posed by Russia, with its hybrid warfare, vast territory, and intricate defense networks, underscore the significance of understanding and leveraging operational art. Just as the German Wehrmacht aimed to use tactical victories for strategic success in World War II or the Mongols utilized operational maneuver to expand their empire, modern militaries must see beyond the immediate battlefield. To successfully counter challenges such as those posed by Russia, military leaders must grasp not only the tools and techniques of the modern age but also the universal lessons from history. Operational art serves as that bridge between the lessons of the past and the challenges of the present.

China: Universal Themes and Historical Value

To understand the importance and relevance of operational art in the context of China, one must first appreciate the historical trajectory of Chinese military thinking and its contemporary ramifications.

China's military history is replete with strategies and tactics that focus on the operational level. Ancient strategies like "36 Stratagems" and the emphasis on *shi*—trategic advantage or positioning—reflect a deep cultural appreciation for the nuances of operational maneuver.[34] These concepts are not mere relics of the past but continue to inform the People's Liberation Army (PLA) strategies in the modern era.

China's current military strategy places a significant emphasis on the maritime domain, with the aim of breaking through the First Island Chain, a series of archipelagos that stretch from Japan to the Philippines.[35] The operational challenges here are immense, ranging from antisubmarine warfare to anti-access/area denial strategies against potential adversaries. Operational art in this scenario would involve coordinating naval, aerial, and missile assets to ensure sea control and dominance. Much like Russia, China has shown a proclivity for operations in the gray zone—actions that are aggressive but fall short of traditional warfare. The PLA's activities in the South China Sea, including the building of artificial islands and militarization of disputed features, are examples of this.[36] Operational art, in this context, is about achieving strategic objectives without crossing the threshold of open conflict.

Reflecting the modern battlefront's digital nature, China has emphasized the integration of cyber capabilities into its military doctrine.[37] Operational art here would involve synchronizing electronic warfare, cyberattacks, and kinetic operations to degrade enemy capabilities and communications.

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34. Xiaoyu Pu and Chengli Wang, "Rethinking China's Rise: Chinese Scholars Debate Strategic Overstretch," *International Affairs* 94, no. 5 (2018).

35. Toshi Yoshihara, "China's Vision of Its Seascape," *Asian Politics & Policy* 4, no. 3 (2012).

36. Tara Davenport, "Island-Building in the South China Sea: Legality and Limits," *Asian Journal of International Law* 8, no. 1 (2018).

37. Richard Alan Clarke and Robert K. Knake, *Cyber War: The Next Threat to National Security and What to Do about It* (New York: Tantor Media, 2014).

On land, the Belt and Road Initiative's strategic implications require the PLA to be capable of securing and defending vast stretches of infrastructure, potentially even in foreign territories.[38] This again necessitates a detailed operational approach to coordinate actions across vast geographies.

While the tools and tactics have evolved, the essence of operational art remains the same: ensuring that individual actions serve a broader strategic purpose. China's contemporary military posture, whether in the digital realm or the physical expanses of the Indo-Pacific, requires an intricate dance of coordination, foresight, and execution—the very hallmarks of operational art. As one analyzes China's strategic posture, it becomes clear that the universal principles of operational art, echoing from the annals of history, remain critical. Just as Sun Tzu emphasized the importance of strategy, deception, and environmental advantage, today's military leaders must blend ancient wisdom with modern capabilities to navigate the complex strategic landscape posed by China.

Counterinsurgencies: Universal Themes and Historical Significance

Historically, insurgencies have been rooted in political, socioeconomic, and cultural grievances. Their asymmetric nature means regular armies often grapple with an enemy that does not confront them in open battles but melts into the civilian populace, making conventional military strategies less effective. The challenges posed by insurgencies have perennially necessitated higher-order coordination between strategy and tactics: the very essence of operational art.

Classic works on counterinsurgency, from British officer T. E. Lawrence's experiences in the Arab Revolt to French officer David Galula's doctrine derived from the Algerian War, stress the significance of understanding the local population and winning "hearts and minds."[39] The success of these campaigns often pivoted on nuanced, localized operations backed by overarching strategic objectives: operational art in practice. Modern COIN operations also emphasize protecting and winning over the civilian populace, recognizing that insurgencies thrive amidst civilian support. Operational art in this domain would entail coordinating military actions, civil affairs, and psychological operations to gain popular trust and isolate insurgents.

Gathering actionable intelligence is paramount in COIN. This requires seamlessly integrating human intelligence, signals intelligence, and other intelligence assets to guide kinetic operations. The synchronization of intelligence with military actions epitomizes operational art. Striking a balance between aggressive operations against insurgents and nonkinetic operations, like development projects and governance initiatives, is also crucial. Operational art here ensures

38. Sean Braniff, "Leveraging Regional Partners: On 'US Grand Strategy, the Rise of China, and US National Security Strategy for East Asia,'" *Strategic Studies Quarterly* 15, no. 4 (2021).

39. Thomas Edward Lawrence, *The Seven Pillars of Wisdom* (New York: Graphic Arts Books, 2020); and David Galula, *Counterinsurgency Warfare: Theory and Practice* (New York: Bloomsbury Publishing USA, 2006).

tactical actions, kinetic or otherwise, align with the broader strategy of stability and governance. Understanding local customs, norms, and grievances allows forces to craft effective messaging and strategies, undercutting insurgent narratives. Operational art in COIN involves marrying cultural understanding with tactical actions for maximum impact.

Operational art's universality in COIN operations is evident when one considers the delicate balance military leaders must strike. Every action, from targeted raids to community engagements, must serve the broader objective of stability, governance, and winning popular trust. Historically, the most successful counterinsurgency campaigns, whether by Lawrence in the deserts of Arabia or by Galula in the streets of Algiers, seamlessly blended tactical prowess with strategic vision, showcasing the timeless and universal essence of operational art.

In the kaleidoscope of modern warfare, counterinsurgencies stand out as complex, human-centric operations. Here more than anywhere, the enduring principles of operational art—harmonizing strategy with tactics, ensuring every action serves a larger purpose—are not just advantageous, but indispensable.

Conclusion

> *When all is said and done, it is really the commander's coup d'oeil, his ability to see things simply, to identify the whole business of war completely with himself, that is the essence of good generalship.*
>
> — Carl von Clausewitz[40]

Operational art can be dated back to Prussia and Napoleonic France, but the main conclusion of this article is that the tools of operational art remain relevant to the United States in the current and evolving threat landscape. Operational art will apply to planning vis-à-vis Russia, China, and counterinsurgencies. The toolset of operational art is relevant not only to third-generation warfare but also to fourth- and fifth-generation warfare. Theorists and planners must be flexible in how they import the lessons and precepts of operational art into the current and evolving threat landscape.

40. Carl von Clausewitz, *On War*, ed. and trans. Michael E. Howard and Peter Paret (Princeton: Princeton University Press, 1984), 578.

Decision Advantage and Initiative

Completing Joint All-Domain Command and Control

Brian R. Price

This article defines *decision advantage* and *initiative* in the context of John Boyd's observe, orient, decide, act (OODA) loop and his "Organic Design for Command and Control" (1987) analysis. Boyd's thoughts were far ahead of their day but resonate clearly in the emerging operating environment. The outcome of decision advantage is initiative. Moreover, decision advantage is not only a condition, but also the process needed to operationalize such advantage. Because humans remain key to effective Joint all-domain command and control, planners and strategists must be educated regarding the doctrinal nuances of these critical concepts.[1]

Using the Air Force's conception of decision advantage as a foundation, this article proposes a firmer connection between decision and execution—the "d" and "e" of the planning, decision, and execution process. Decision advantage is rooted in retired US Air Force Colonel John Boyd's conception of command and control as a decision loop, and this article extends his ideas through the concept of initiative. The proposed working definition of initiative and modification to the Air Force's definition of decision advantage completes the concept of Joint all-domain command and control (JADC2). These changes help the Joint Force create a decision-making climate that encourages the education needed to fit situational awareness into the broader understanding and less easily quantifiable swirl of human factors.

Introduction

Decision Advantage: The product of situational understanding, the ability to assure and exchange information, make and communicate decisions by maintaining advantages in all domains.

Air Force Doctrine Publication 3-99, November 19, 2021[2]

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1. The author wishes to thank the early readers, particularly the peer reviewers, for their valuable comments.

2. *The Department of the Air Force Role in Joint All-Domain Operations*, Air Force Doctrine Publication (AFDP) 3-99/Space Force Doctrine Publication (SDP) 3-99 (Maxwell AFB, AL: Curtis LeMay Center for Doctrine Development and Education, November 19, 2021), 4, https://www.doctrine.af.mil/.

> *Civilian and military leaders make timely decisions at the speed required to outpace adversaries. Decision making requires a common intelligence picture and a shared understanding of global force posture to see operations in real time: identify opportunities to seize the initiative, and identify trade-offs, risk, and opportunity costs. Automation, preplanned responses, and mission command are essential to act at the required speed of relevance.*
>
> Joint Publication 3-0, June 2022[3]

The Department of Defense's embrace of Joint all-domain operations (JADO), formerly multidomain operations, has driven a flurry of developmental and organizational activity sparked by perceived changes in the operating environment and specific near-peer adversary efforts to challenge American security leadership. Command and control is central to all service conceptions of multidomain or all-domain operations. Given the potential for the radical impact of emerging technologies on previous limits to the planning, decision, and execution cycles, this article—an outgrowth of Air University's 2020 JADC2 conference—examines the concept of decision advantage through the lens of Boyd's 1987 briefing, "Organic Design for Command and Control."[4]

While Boyd's irascible character reduced the effectiveness of his efforts to help the defense establishment, his late-1980s writings seem eerily prescient when considering the intent and architecture of JADC2. A study of Boyd's ideas can help the current generation of planners and architects understand the possibilities better.[5]

No matter the technology employed to banish the fog and friction of war, human factors—beliefs, trust, shared vision, identity, knowledge, experience, education and training, and others—are arguably as important to the JADC2 enterprise as are the sensor grid, open-data standards and interchange, mesh connectivity, cloud or edge computing, human-machine teaming, machine learning, or even artificial intelligence (AI). Russia's approaches to the problem suggest Russian planners understand human factors as one of the weakest links or potentially the strongest aspect of the JADC2 enterprise.[6]

This article examines a fundamental tenet that seems to underpin the Defense Department's JADC2 enterprise—Boyd's observe, orient, decide, act (OODA) loop. This article does not challenge the Department's embrace of this decision-making model. Furthermore, while it examines JADC2 doctrine and architectural designs, due to space considerations, this article does not discuss the applicability of the development of doctrine as a practice.

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3. *Joint Campaigns and Operations*, Joint Publication (JP) 3-0 (Washington, DC: Chairman of the Joint Chiefs of Staff, June 2022), IV-5.

4. John Boyd, "Organic Design for Command and Control," Boyd's Work (website), May 1987, https://static1.squarespace.com/.

5. Brian R. Price, *Eagles, Falcons & Warthogs: Gen. "Bill" Creech, Col. John Boyd and the Struggle to Remake the Tactical Air Forces in the Wake of Vietnam* (Annapolis, MD: Naval Institute Press, forthcoming); and retired General John Michael "Mike" Loh, USAF, interview conducted by the author, 2017.

6. Ofer Fridman, *Russian "Hybrid Warfare": Resurgence and Politicization* (Oxford, UK: Oxford University Press, 2018).

Background

The concept of a revolution in military affairs is hotly contested. Still, many US military, Ally, and partner planners recognize an ongoing revolution, noted also by Russia and China, that harnesses emerging technologies. These technologies include the sensor-grid, open-architecture data framework, machine learning ("weak" AI), cloud or edge computing, and advanced analytics. Moreover, these technologies threaten to overrun the existing planning, decision, and execution process.[7] Joint all-domain command and control seeks to enable the next generation of decisionmakers with a fundamental advantage, but how this technology will shape future planning, decision, and execution cycles has not yet been precisely articulated.

The decision itself, however, does not provide advantage; rather, the action resulting from the decision—the seizing and maintaining of the initiative—yields advantage. Initiative is an underappreciated concept within the security community, and it is difficult to assess, though it is similar to the concept of momentum in sports.

The problem of linking decision to action gives rise to a debate between military planners: is decision advantage a condition resulting partially from information advantage, training, education, and other factors within the human domain, or does it represent the process necessary to realize expected benefits? In fact, considering both concepts is essential in formulating a comprehensive doctrinal definition of decision advantage. No amount of situational awareness will substitute for understanding by junior or senior leaders. Furthermore, even perfectly executed operations may fail if they operate under a flawed strategy, arguably as was done in Afghanistan.

Foundations for Defining Decision Advantage

While senior leadership adopted the terms information advantage and decision advantage to capture the hoped-for benefits of the JADO approach, for some years, decision advantage stubbornly eluded a DoD definition. The concept of decision advantage was hinted at in unclassified JADC2 and multidomain operations/JADO documents, but it was not clearly defined, despite the fact the JADC2 enterprise's entire purpose is "the art and science of decision-making and the ability to translate those decisions into action, leveraging capabilities across all domains and with mission partners to achieve an operational advantage in both competition and conflict."[8] Finally, in November 2021, the Air Force published its definition.[9]

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7. Joseph R. Biden Jr., *U.S. National Security Strategy* (Washington, DC: White House, October 2022), https://www.whitehouse.gov/; and State Council Information Office of the People's Republic of China, *China's National Defense in the New Era* (Beijing: State Council Information Office, July 2019), http://www.chinadaily.com.cn/.

8. JADC2 Cross-Functional Team, "Joint All-Domain Command and Control (JADC2) High Level Operational Graphic (OV-1)," version 1.0, briefing slide 4, Air Combat Command Headquarters (HQ), August 2020.

9. AFDP 3-99/SDP 3-99.

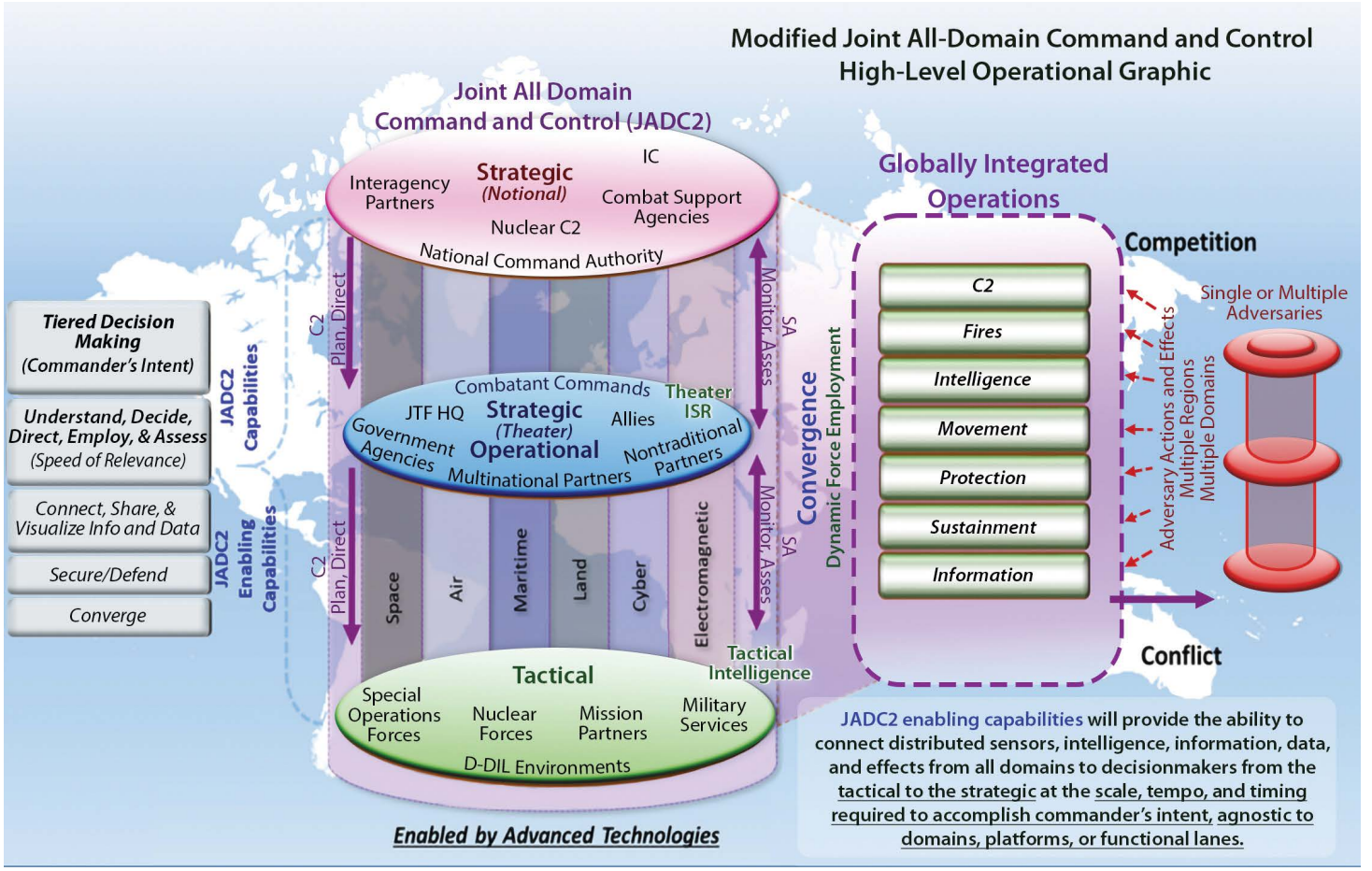

Figure 1. Modified JADC2 high-level operational graphic

Some may conclude JADC2 is decision advantage. The above definition offers useful connectivity across the continuum of conflict, though it does not expressly connect the concept to JADC2's technical architecture. This definition also appears on a key 2020 Air Combat Command graphic summary of JADC2 (fig. 1), where the mission to "blunt the enemy's advance with overwhelming decision superiority" is assigned, but again without defining what decision advantage means.[10]

The JADC2 conception is an architecture for delivering superior situational awareness. Understanding JADC2 requires at the very least deep domain, and ideally, cross-domain knowledge, reflecting key perspectives that collide and interact to create context.

Within the US military, human-machine synergy augments the decision-making process. Army multidomain operations doctrine notes that "man-machine interfaces, enabled by artificial intelligence and high-speed data processing, improve human decision-making in both speed and accuracy."[11] *The U.S. Army in Multi-Domain Operations 2028*, US Army Training and Doctrine Command (TRADOC) Pamphlet 525-3-1, emphasizes attacks against the opponent's intelligence, surveillance, and reconnaissance complex: "In conjunction with partners and the Joint Force, Army forces counter the adversary's reconnaissance and conduct deception to create uncertainty within an adversary's decision making process." It further notes, "Demonstrated capabilities in competition undermine the adversary's information warfare operations and generate complexity and uncertainty in their decision making process."[12]

This is similar to Russia's approach, which aims to inject ambiguity into the decision cycle to create maneuver space. It also resembles China's approach to decision-making, where "systems destruction warfare" is conducted to deny key information and cause paralysis.[13]

While the Army pamphlet does not define or use the term decision advantage, it does use decisive spaces, which it defines as "locations in time and space (physical, virtual, and cognitive) where the full optimization of the employment of cross-domain capabilities generates a marked advantage over an enemy and greatly influences the outcome of an operation."[14] This appears to be an adaptation of the familiar concept of decisive points,

10. Air Combat Command HQ, "JADC2 Overview" briefing, undated, slide 6.

11. *The U.S. Army in Multi-Domain Operations 2028*, US Army Training and Doctrine Command (TRADOC) Pamphlet 525-3-1 (Fort Eustis, VA: TRADOC, December 6, 2018), 20, https://adminpubs.tradoc.army.mil/.

12. TRADOC Pamphlet 525-3-1, 31.

13. David Kilcullen, *The Dragons and the Snakes: How the Rest Learned to Fight the Rest* (Oxford, UK: Oxford University Press, 2020); Charles K. Bartles, "Recommendations for Intelligence Staffs Concerning Russian and New Generation Warfare," *Military Intelligence*, October–December 2017, 11; Fridman, *Russian "Hybrid Warfare"*; and Li Yousheng, Li Yeng, and Wang Yongha, eds., *Lectures on the Science of Joint Campaigns* (Beijing: Military Science Press, 2012), 74.

14. TRADOC Pamphlet 525-3-1, 20.

and it parallels the Chinese conception of selecting key points in the opponent's system and designing a countersystem to oppose it.[15]

TRADOC 525-3-1 also discusses predictive sustainment operations:

> Precision logistics is enabled by: a sustainment enterprise resource planning *decision support system* (emphasis added) with predictive analysis tools and the ability to resupply without request and/or redirect supplies based on priority; a real-time common operating picture viewable by commanders and logisticians at echelon.[16]

Such a system would be absolutely necessary to support agile combat employment or other forms of dynamic force employment.

Finally, the Army's integrated employment operations seek to orchestrate "information related capabilities (IRC) in concert with other lines of operations to influence, deceive, disrupt, corrupt, or usurp the decision making of enemies and adversaries while protecting our own" as well as to influence the enemy's and population's will to fight.[17] TRADOC 525-3-1 emphasizes the degradation of enemy decision-making capacity and suggests protecting similar US capability. In the TRADOC 525-3-1 conception, the advantage is won chiefly by attacking enemy cognition rather than building a superior process and information environment.

Former Army Futures Command Commander General John M. Murray articulated the clearest Army expression of decision advantage when he referenced former Army Chief of Staff General James McConville's use of the term decision dominance in a March 2021 interview: "This is a developing definition, but right now, [decision dominance] is the ability for a commander to sense, understand, decide, act and assess faster and more effectively than any adversary."[18] Murray's conception is strikingly close to Boyd's OODA loop.

Approaching the definition from the perspective of intelligence, another analysis observes that available, suitably analyzed, and protected intelligence "can provide a decision advantage so the decision-maker is better informed and understands more aspects of an issue in ways that would not be possible without the intelligence" and that "this decision advantage can be especially critical when adversaries or competitors do not possess the same insights or do not know what the opposing decision-maker does."[19]

Drawn from the Intelligence Community, this conception of decision advantage has many strengths. In the comparison of the decisionmaker to their opponent, being "better

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15. Antoine-Henri de Jomini, *The Art of War*, trans. W. P. Craighill and G. H. Mendell (Westport, CT: Greenwood Press, 1862), 80; and *Joint Planning*, JP 5-0 (Washington, DC: CJCS, December 1, 2020), https://www.jcs.mil/.

16. TRADOC Pamphlet 525-3-1, B-1.

17. TRADOC Pamphlet 525-3-1, C-9, fn 49.

18. Sydney J. Freedberg Jr., "Army's New Aim is 'Decision Dominance,'" Breaking Defense, March 17, 2021, https://breakingdefense.com/.

19. John MacGaffin and Peter Oleson, "Decision Advantage, Decision Confidence," *Intelligencer: Journal of US Intelligence Studies* 21, no. 3 (Fall–Winter 2015), 41, https://www.afio.com/.

informed" and "understanding more aspects of an issue" are fundamental. These conditions speak to the quality of information and context, leading to superior understanding.

In discussing JADC2 and the Global Information Dominance Exercise in 2021, US Northern Command officials argued "the new artificial intelligence will instantly pull together all sorts of data to give commanders a clear picture of the battlefield, enabling good, fast decisions."[20] Of this capability, these officials noted that "the key here is that the AI system—not a slow human as in the past—will rapidly provide and constantly upgrade best options to ensure a high probability of intercept." A recent US Northern Command J8 JADC2 development lead, explained,

> The human now can have more time and more options to be able to make a decision. . . . [The idea is to provide] an earlier and better understanding about what competitors are doing . . . this tool allows us to be able to see: what are competitors doing on a day-to-day basis, at their airfields, at their command and control facilities, at the places that they would be operating from for their maritime operations.[21]

In 2020, then Commander of US Northern Command General Terrence O'Shaughnessy stated, "[JADC2] is going to inform our decision-makers, it's going to help them make decisions that, like playing chess, are thinking two or three moves downstream. It's going to give decision-makers, at the speed of relevance, the ability to make really complex decisions."[22]

Boyd's OODA Loop, Organic C2, and the Concept of Initiative

A review of Boyd's OODA loop, a key foundational concept underpinning JADC2, reveals the aspects of the proposed notion of decision advantage not captured in existing doctrinal and operational documents. The OODA loop decision-cycle concept lies at the core of the JADC2 and JADO vision and architecture documents, with the assumption that acting faster and with more complete information is necessary and inevitable, given technological developments.[23] This assumption was challenged by Boyd.

The problems of ambiguity, initiative, and decision captured and commanded the attention of Boyd in the late twentieth century. While some of Boyd's accomplishments may be overstated, his enduring contribution has shifted strategists, planners, and operators from mass-based to tempo- and disruption-based conceptions of war, conflict, and

20. Theresa Hitchens, "Exclusive: NORTHCOM Developing, Testing AI Tools to Implement JADC2," Breaking Defense, March 5, 2021, https://breakingdefense.com/.

21. Hitchens.

22. Theresa Hitchens, "The Key to All-Domain Warfare Is 'Predictive Analysis,' Gen. O'Shaughnessy," Breaking Defense, May 5, 2020, https://breakingdefense.com/.

23. Frans Osinga, "The Enemy as a Complex, Adaptive System: John Boyd and Airpower in the Postmodern Era," in *Airpower Reborn: The Strategic Concepts of John Warden and John Boyd*, ed. John Andreas Olsen (Annapolis, MD: Naval Institute Press, 2015).

competition.[24] These ideas are even more relevant in today's hyper-paced technological innovation environment. Boyd was early—perhaps a little too early—to the mark. Still, his work holds considerable insight applicable to today's environment where ambiguity is the weapon of choice for US near-peer opponents.

The widespread acceptance of the simplified OODA loop model for decision-making attests to the pervasive acceptance of Boyd's compelling heuristic. In military, business, and strategic writing, the term decision cycle is often synonymous with OODA. In figure 1, formulated by all major DoD stakeholders, the cycle is rendered as "understand, decide, direct, employ, assess." Within the JADC2 literature, the OODA idea serves as a core foundation, a set of assumptions that should be carefully examined.

Throughout his Air Force career, Boyd contributed significantly to fighter tactics instruction and to the realization and engineering of maneuverability in fighter design through his energy maneuverability theory, developed with mathematician Tom Christie. Post-career, he developed his core ideas, incorporating notions of complex, adaptive systems now reflected in DoD doctrine. Boyd approached conflict more broadly through his manifold iterations of the "Patterns of Conflict" briefing and a series of other less titanic but insightful, if densely packed, works.[25]

While "Patterns" has received much attention, one of his lesser-known 1987 briefings, "Organic Design for Command and Control," defined the OODA loop as it is commonly used today.[26] In "Organic Design," Boyd articulated his vision. The intent was not only to operate faster but also to create the circumstances that would lead to confusion and paralysis for the opponent, to "operate inside the adversary's observation-orientation-decision-action loops to enmesh the adversary in a world of uncertainty, doubt, mistrust, confusion, disorder, fear, panic chaos . . . and/or fold the adversary back inside himself so that he cannot cope with events/efforts as they unfold."[27] The second part, "and/or fold the adversary back inside of himself so that he cannot cope with events/efforts as they unfold," is very close to the Russian concept of reflexive control and to the Chinese approach of breaking down system links to isolate aspects of that system, such that individual parts become less than the sum of whole.[28]

Boyd went on to underscore the critical nature of social, intellectual, and cultural aspects of command and control, concluding that the cohesion provided by "genetic heritage,

24. Price, *Eagles, Falcons & Warthogs*; Ian T. Brown. *A New Conception of War: John Boyd, the U.S. Marines, and Maneuver Warfare* (Quantico, VA: Marine Corps University Press, 2018), ch. 4; and Robert Coram's *Boyd: The Fighter Pilot Who Changed the Art of War* (Boston: Back Bay Books, 2004).

25. John Boyd, "Patterns of Conflict," Boyd's Work, December 1986, https://static1.squarespace.com/.

26. Stephen Robinson, *The Blind Strategist: John Boyd and the American Way of War* (Dunedin, NZ: Exisle Publishing, 2021).

27. Boyd, "Organic Design," slide 7.

28. Keir Giles, James Sherr, and Anthony Seaboyer, *Russian Reflexive Control* (Kingston, Ontario: Royal Military College of Canada, 2017), https://www.researchgate.net/; and Timothy Thomas, "Russia's Reflexive Control Theory and the Military, *Journal of Slavic Military Studies* 17, no. 2 (August 2004), https://www.tandfonline.com/.

previous experiences, and unfolding circumstances" helped create a picture of the environment based on filters.[29] Filters come from the human experience—tangible and intangible elements that shape observation and orientation. In turn, human factors are powerful contributors to winning through the decision cycle process. Boyd argued that this process is command and control: "the process of observation-orientation-decision-action represents what takes place during the command-and-control process—which means that the OODA loop can be thought of as being the C&C loop."[30]

The JADC2 architecture and concepts reflect developments that seek a dramatic increase in the operational tempo and, simultaneously, of complexity. This not only shortens the cycle but also compresses it toward what has been called an "OODA point," the point at which the speed and complexity of data sources become too much for humans to handle.[31] Operators, therefore, are increasingly compelled to rely on human-machine teaming, machine learning, and ultimately, AI. Consequently, near-peer competitors China and Russia pursue their approaches to getting inside the US planning, decision, and execution cycle.[32]

The clear compression of decision-cycle potential in near-term competition and conflict is important, but this conception may be incomplete. Frans Osinga, a longtime student of Boyd's thought, carefully argued the OODA loop has often been misconstrued if aligned purely with time.

> The comprehensive overview of Boyd's work shows that the OODA loop represents and means more than a decision process, and the model contains more elements for victory than information superiority and speed. . . . The first misconception . . . concerns the element of speed. The rapid OODA looping idea suggests a focus on speed of decision-making, and 'out-looping' the opponent by going through consecutive OODA cycles faster.[33]

Phrased this way, Osinga could be discussing JADC2's core assumptions that the computing/data architecture, as proposed, leaves much out—particularly the human dimension, sometimes termed the human domain.[34] These elements are necessary to account for the adversary's intentional degradation of the system, disinformation, and ambiguity-seeking delays.

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29. Boyd, "Organic Design," slide 13.

30. Boyd, slide 26.

31. Jeffrey M. Reilly, "OODA Point: The Need for an Airman's Approach to Operational Design," working paper (Maxwell AFB, AL: Air Command and Staff College, November 20, 2020).

32. Lester W. Grau and Charles K. Bartles, *The Russian Way of War: Force Structure, Tactics and Modernization of the Russian Global Forces* (Fort Leavenworth, KS: Foreign Military Studies Office, 2017); and Andrew Scobell et al., *China's Grand Strategy: Trends, Trajectories, and Long-Term Competition* (Santa Monica, CA: RAND Corporation, 2020), https://www.rand.org/.

33. Frans P. B. Osinga, *Science, Strategy and War: The Strategic Theory of John Boyd* (New York: Routledge, 2007), 235.

34. Julie Janson, "OTH Video Primer 1: The Human Domain," Over the Horizon, February 2, 2018, https://othjournal.com/.

Boyd's work failed to grasp and support the potential benefit of leveraging sensor and computer technology to dramatically improve situational awareness—as with the Air Force's Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN), airborne early warning and control system (AWACS) E-3 Sentry, and E-8C Joint Surveillance Target Attack Radar System (Joint STARS). It seems clear his dismissal of the post-Vietnam version of the sensor network overcorrected.[35] Few Americans in the post-Vietnam world, or even the post-9/11 battlefields, would easily go to war without these platforms or their forthcoming replacements, despite challenges to their survivability in a near-peer operating environment. Nonetheless, the human factors Boyd proposed in his "alternate vision" for "organic" command and control deserve another look, particularly in light of Russian and Chinese efforts to aggressively inject ambiguity into the competition and conflict environments, or to deny access to the electromagnetic spectrum, countering the clarity sought in JADC2.

The corpus of Boyd's work developed this theme over almost 20 years. In "Organic Design," he noted failures with contemporary command and control in operations, with the evacuation of Saigon (1975) and with Desert One (1980):

> The institutional response for overcoming these fiascos is more and better sensors, more communications, more and better computers, more and better display devices, more satellites, more and better fusion centers, etc.—all tied into one giant fully informed, fully capable C&C system. This way of thinking emphasizes hardware as the solution. . . .
>
> I think there is a different way—a way that emphasizes the implicit nature of human beings. . . .
>
> [We] need insight and vision. . . . focus and direction. . . . adaptability. . . . [and] security.[36]

Boyd's conception of post-Vietnam efforts to overcome fog and friction resembles today's sensor grid, data architecture, and emphasis on cloud/edge computing. While Boyd clearly missed the substantial benefits provided through situational awareness when the command-and-control system operates—as has been demonstrated with air and sensing operations over Afghanistan, Iraq, Syria, and elsewhere—his point about the power of human beings, the human domain—must not be overlooked as the Defense Department attempts to build a robust, capable, and agile JADC2 system.

Extrapolating from Carl von Clausewitz, Boyd concluded,

35. Price, *Eagles, Falcons, and Warthogs*.
36. Boyd, "Organic Design," slides 3–4.

> The atmosphere of war is friction.
>
> Friction is generated and magnified by menace, ambiguity, deception, rapidity, uncertainty, mistrust, etc.
>
> Friction is diminished by implicit understanding, trust, cooperation, simplicity, focus, etc.
>
> In this sense, variety and rapidity tend to magnify friction, while harmony and initiative tend to diminish friction.[37]

The JADO approach grasps many of these aspects, seeking to reduce fog and friction through pervasive sensor, data resiliency, and edge computing—creating confusion by simultaneous action in multiple domains, getting inside the opponent's OODA loop. But the current descriptions of JADC2 still emphasize speed and information dominance. They do not yet seem to embrace the service culture or human changes necessary to realize the full potential of the JADC2 concept or perhaps more urgently to guard against the opponent's efforts to create ambiguity, confusion, disorder, isolation, and delay, if not paralysis. The approaches taken by China and Russia noted above aim to dislodge the US decision cycle, particularly during the critical orientation phase.

Boyd defined orientation as the crucial step within the OODA loop. He wrote that "orientation is the schwerpunkt"—or center of gravity—and it "represents images, views, or impressions of the world shaped by genetic heritage, cultural tradition, previous experiences, and unfolding circumstances."[38] In other words, the hard-data view of the world produced by JADO's information advantage network will be filtered by staff and decision-makers based on their shared and unique perspectives.

Participants' ability to achieve unity of effort will require shared experience, culture, and trust. In Boyd's phrasing, "orientation is an interactive process of many-sided implicit cross-referencing projections, empathies, correlations, and rejections that are shaped by and shape the interplay of genetic heritage, previous experiences, and unfolding circumstances."[39] More provocatively, he offers a decentralized view of command and control, favoring leadership in place of command and appreciation (monitoring) in place of control. Boyd emphasized the power of coordinated, "harmonic" decentralization, and stated that "appreciation and leadership offer more appropriate and richer means than C&C for shaping and adapting to circumstances."[40]

Boyd clearly understood the purpose of driving action at and through the adversary's decision cycle was to create confusion, disorder, and paralysis. It is worth restating that

37. Boyd, slide 8.
38. Boyd, slides 16 and 13.
39. Boyd, slide 15.
40. Boyd, slide 32.

the human factors, including beliefs, trust, shared vision and identity, knowledge, experience, education, and training, are as important to the JADC2 enterprise as the sensor grid, open-data standards and interchange, mesh connectivity, cloud/edge computing, human-machine teaming, machine learning, or even AI—if it ever fully develops. Human factors will be the weakest links and the strongest aspects of the JADC2 enterprise.

The Concept of Initiative

Key human factors govern the concept of initiative. Initiative, or driving the action, is foundational to competition and conflict through the OODA model. Within military circles especially, there is sometimes a belief that taking an action—any action—is better than ceding the initiative to the opponent.

Initiative is discussed extensively in the newest version of Joint Publication 3-0, *Joint Campaigns and Operations*. In the section on Joint functions, initiative is mentioned six times, connected expressly with command and control, the concept of mission command, and sustainment.[41] Appendix A is associated with the principle of offensive Joint operations—"the purpose of an offensive is to seize, retain, and exploit the initiative"—but initiative itself is not defined.[42]

One concern with associating initiative with offense is that initiative can also be associated with defense and invitation: if one invites the opponent to take an action, and they do, the opponent has the initiative even in defense. This might seem to be offense masking as defense, but the strict usage associating initiative with offense creates a false expectation among staff officers and commanders that offense equals initiative.

The concept of initiative as understood apart from the DoD lexicon is useful in defining what is sought through decision advantage. JP 3-0 mentions initiative nearly 40 times and is discussed as an operational phase—"exploit the initiative to achieve operational-level objectives."[43] Specifically, "the deployment of forces associated with seizing the initiative may have a deterrent effect sufficient to dissuade an enemy from conducting further operations, returning the [operating environment] to a more stable state."[44]

Further, initiative is closely associated with offensive in the principles of Joint operations: "Offensive operations are how a military force seizes and holds the initiative while maintaining freedom of action and achieving meaningful objectives."[45] It is not the decision itself that is important but the initiative and control the decision can afford.

A useful definition of initiative is found in the *Oxford English Dictionary*: "to take the lead, make the first step, originate some action," and "the power, right or function of initiating something, hence, to possess or have the initiative," and "to drive or force . . . by

41. JP 3-0, III-5 (x3), III-14, III-41, III-48.
42. JP 3-0, A-1.
43. JP 3-0, VII-27.
44. JP 3-0, IV-15.
45. JP 3-0, A-1.

some impulsive power."[46] The concept of initiative connects decision-making with action. The force compels the opponent to restart the OODA cycle, costing time and sowing doubt, confusion, ambiguity, mistrust, and the other detractors from confidence, certainty, clarity, and trust that Boyd identified. Thus, this article offers the following working definition for initiative: Initiative is the impulsive power resulting from timely decision and action, enabling freedom of maneuver while constraining an opponent's options.

The goal of competitive or conflict-based decision-making is to drive the action, forcing or inviting the opponent to respond; acting as the subject of action rather than being the object; and by action, compelling the opponent to reobserve, reorient, redecide, and react. Initiative is a zero-sum, binary resource; one or the other combatants may possess it, but both cannot have it simultaneously. It is possible, however, that neither has it, and there can be a difference in perception versus reality. One can believe they have the initiative when they do not.

The initiative can be clearly felt in a game of chess, Go, or a single-combat fight. If one feels compelled to make a given move when one would clearly prefer to make another, the opponent holds the initiative as the driver of that action. If the situation is reversed, the adversary loses freedom of action and is forced to react rather than acting as they would like.

This concept extrapolates to the tactical, operational, and strategic levels. It is part of the reason the study of strategy games, martial arts, or military and political history is useful for building military domain expertise; through experience, one identifies patterns that can distill order from chaos, building the confidence that enables decision, in turn conveying the initiative. Any definition of decision advantage should include the intent to capture and retain the initiative.

Decision Advantage: Condition versus Process

One argument that has plagued military planners is whether decision advantage represents a condition or a process. The condition view argues decision advantage is a state, a blend of understanding aided by technology that enables decision. The process view argues the condition is meaningless if not connected to a means of achieving it, the concrete methods through which understanding will be turned into plans and action.

For some years, graduates of the Joint All-Domain Strategist (formerly Multi-Domain Operations Strategist) program at Air Command and Staff College have learned to augment the Joint planning process through threat-informed decision-support matrices. By anticipating the information necessary to drive a decision point at the operational or strategic level, such matrices frame the collection of the commander's critical information requirements, analyze and clearly present risk, and connect the decision into an operational or strategic design. Even using a manual process, the development and use of decision-support matrices, while staff-intensive, enables faster and more informed decision-making in the moment.

46. *Oxford English Dictionary*, compact ed. (Oxford, UK: Oxford University Press, 1971), s.v. "initiative."

COA 1: Phase 1 PREPARE

Decision Point	NAI/ TAI	Event	Decision Required	Decision Criteria	Assets Available	CJTF Actions
Turn Land Component Forces to the Azerbaijani Border 1		LC forces move to border for NW Iraq Land Exercise (D-1)	Supreme Leader declares C-Day LC authorized to deploy	Phase 0 (Shaping) Complete Homeland Defense Capability Green	**Air** - ISR **Maritime** - ISR; SPOD defense SOF - ISR; IO **Land** - Exercise posturing units; Force Pro **EMS** - Jx (Dominance of spectrum req'd **Space** - NTM	Deploy LC to AZJ border Begin IO campaign IADS to highest readiness

Assumptions	Assumed Response	CCIRs
Provide unambiguous warning to US and AZJ No ground force opposition from US ISR collection by US and other nations	AZJ press release denouncing forces moving toward its border High alert status AZJ defence forces Possible US airstrike on deployed forces	PIR - Readiness posture of US & AZJ - Status of GOAZ - Status of key AZJ infrastructure FFIR - IADS posture/alert/readiness level

Risk	Impact on Mission	Probability of Occurrence	Mitigation	Residual Risk after Mitigation
Turning LC forces to the AZJ border tips off our plan to the US and AZJ	Shortens timeline for our action prior to interference by the US	Moderate	Est history of land exercise on IZ border during Phase 0 Well-publicized exercise in press Plant intel about exercise legitimacy for US	Low
Not turning LC forces to the AZJ border denies ready posture for incursion into AZJ	Dramatically slows timeline and forces a change in the overall plan	High	None	High

Figure 2. Decision support matrix for an exercise in the Air Command and Staff College Joint All-Domain Strategist program

Through automation, under the JADC2 architecture, it should be possible to largely automate the collection and presentation of decision-support matrices as crafted by the staff, including changes needed to dynamically create new force and resource alignments, enabling significantly faster decisions and operationally relevant action.

For this idea's supporters, creating an automated system around the known decision framework operationalizes the concept of decision advantage. In a sense, the process view

captures the requirement for the connection of action from decision discussed above as initiative. Decision advantage is thus the condition of holding an advantage. Yet without a process, such advantage is meaningless as it does not translate into a seizure of the initiative.

Defining Decision Advantage

Given the nature of the OODA-loop concept emphasizing human factors, the speed and informational advantage, and the centrality of the concept of initiative, this article proposes a definition for decision advantage. The first part defines decision advantage itself, while the second part sets JADC2 within the context of the OODA concept and human factors, as noted through an adversary's operational approaches: Decision advantage is having access to and recognizing the right information at the right time (information advantage), enabling timely decisions that are transformed into action, and seizing or retaining the initiative.

The US Air Force recently released Air Force Doctrine Publication 3-99/Space Force Doctrine Publication 3-99, *Department of the Air Force Role in Joint All-Domain Operations,* which defines decision advantage as "the product of situational understanding, the ability to assure and exchange information, make and communicate decisions by maintaining advantages in all domains."[47] This definition has much to recommend it. It emphasizes understanding over awareness. Unlike the author's proposal, it emphasizes the centrality of communications and connects decision-making to the need to communicate it. Yet it also proposes the need to maintain advantages in all domains, which may prove impossible in practice—though undoubtedly, this would be a welcome circumstance were it to be somehow attained.

The Air Force definition, however, still lacks the central element that underscores the importance of decision advantage—the conveyance of initiative. A modification of the service definition to more firmly connect decision and initiative could read as follows: The product of situational understanding, the ability to assure and exchange information, and make and communicate decisions to seize or retain the advantage in key domains.

With either definition, decision advantage is supported by superior understanding, confidence, and trust that overcomes ambiguity and creates clarity. Decision seizes and retains the initiative concerning an adversary or competitor, forcing reobservation and reorientation, delaying their decision, and ultimately denying their ability to act or even retain cohesion. Meanwhile, decision advantage seeks to maximize friendly freedom of action, unity, and the ability to steer (the adversary) toward decisions, objectives, and end-states favorable to the United States, expressed in some Russian literature as reflexive control.[48]

Superior understanding flows from relevant knowledge, experience, appropriate intellectual tools, education, and training; confidence flows from a clarity of understanding,

47. AFDP 3-99/SDP 3-99, 4.

48. Timothy L. Thomas, "Russia's Reflexive Control Theory and the Military," *Journal of Slavic Military Studies* 17 (2004), https://doi.org/.

vision, purpose, authorities, and objectives—or things that are known. Trust stands against the unknown by supporting risk through established relationships. The antithesis of decision advantage may thus be paralysis—the inability to orient, decide, and act.

David Epstein has recently and persuasively argued cross-domain and multidomain knowledge—as in academic domains, not necessarily doctrinal warfighting domains—could be valuable in solving wicked problems in a specialized world.[49] If Epstein is correct, education that is broad and deep is necessary to transfer knowledge across domains and find solutions to problems that seem intractable to specialists. Moreover, the inherent limitations of AI known today suggest adaptability and flexibility are the keys to defeating the relatively narrow but lightning-fast machine judgment.[50]

Epstein's argument that cross-domain knowledge is a powerful weapon when facing debilitating ambiguity parallels the military conception of multidomain or all-domain operations as key to achieving an advantage over the adversary. In both views, knowledge or awareness of information from outside a single domain can yield important advantages.

The contrast between the small-unit innovation of Ukrainian forces and the centralized plodding of Russian forces is instructive. Armed with a technological edge and fueled by a passionate desire to defend their homes, Ukrainian civilians and military members have innovated with technology and tactics on the fly, flummoxing their Russian opponents. Technology such as the M142 High-Mobility Artillery Rocket System, American intelligence, surveillance, and reconnaissance, the Javelin missile, and drones have enabled Ukrainian forces to be considerably more agile and capable at long range. The technologies alone are not flummoxing the Russian military, but perhaps the innovation pace coupled with these technologies is.

Similarly, educational breadth may help guard against paralysis, enabling rapid synthesis and resolution of a wicked problem on the fly. This will be necessary, given that the injection of ambiguity and false information will most certainly adversely affect supporting machine calculation and human judgment, leaving humans to fill the gap. Quality education, coupled with training, will be needed to counter the difficulties of purposefully injected ambiguity and the resulting fog and friction as subsystems are attacked and collapse.

In the quest to modernize and harness the potential of emerging technologies, the weakest and strongest points of the JADC2 system will be the human operators and the organizations they operate. Decisionmakers at all levels, however, still need to understand information presented at near-machine speed—they must have situational awareness. Perspective, bias, culture, identity, and other factors give information meaning and provide

49. David Epstein, *Range: While Generalists Triumph in a Specialized World* (New York: Riverhead Books, 2019).

50. Chinese State Council, "Full Translation: China's 'New Generation Artificial Intelligence Development Plan' [2017]," trans. Graham Webster et al., New America Foundation (website), August 1, 2017, https://www.newamerica.org/; and Scott W. Harold, *Defeat: Not Merely Compete: China's View of Its Military Aerospace Goals and Requirements in Relation to the United States* (Santa Monica, CA: RAND Corporation, 2018), 2, https://www.rand.org/.

another set of lenses through which combat information will pass. Education is one counter to stultifying organizational narrowness, a personal bias that may persist even when JADC2 is realized, in whatever form it takes.

Conclusion

Joint all-domain operations seek decision advantage, leveraging all-domain information advantage, created through the sensor grid, cloud- or edge-advanced analytics, and resilient, open-data connectivity in support of mission-command-based planning, decision, and execution cycles that must be faster, smarter, and more robust than those of the opponents. Yet a key concept embedded in the JADC2 published architecture—Boyd's OODA loop—is frequently misunderstood to focus solely on the speed of decision. Boyd also called out the quality of information, noting the whole point of competition in conflict is to inject a barrage of input to disorient the opponent. Further, recent efforts to define decision advantage miss the importance of linking action to decision—the seizing and maintaining of initiative—which is not the same as offense.

Even if JADC2 is successful, today's emerging opponents seek to reduce America's present and near future battlefield advantages through misinformation, misdirection, and selectively attacking elements of the United States' command-and-control systems to create pause, indecision, degradation, and, ultimately, paralysis.

Moreover, human factors that these attacks target are the same ones that, even in a perfect operating environment with near-perfect situational awareness, may distort understanding and lead to poor and ineffective—or even disastrous—decisions. At the same time, humans process changing information more rapidly than machines or organizational systems that embed centralized, machine-like qualities—as with the Russians. If thinkers like Epstein are correct, the human elements of a JADC2 system will be the key weakness and strength of the whole enterprise. This consideration of human breadth could complement JADC2's machine-processed depth to reveal some of what is hidden through the fog and friction of war. ✈

The Other Side of the Deterrence Moon

Elevating "Deterrence from Space" in Strategic Competition

Timothy Georgetti

Current discussions about the intersection of deterrence and space focus exclusively on deterrence *in* space. These conversations fail, however, to consider how the United States can leverage its space assets to deter offensive actions in nonspace domains, a concept this article calls deterrence *from* space. This notion differs from deterrence *in* space in that it reframes space assets as both powerful deterrents themselves and as vulnerable liabilities needing deterrence protection. Given the rise of China's capabilities and ambitions, the United States must not neglect the ways in which deterrence from space can enhance integrated deterrence. Such deterrence includes capabilities such as orbital-class rocket resupply and robust space-based solar power.

Much has been written about how best to deter US adversaries, most importantly the People's Republic of China (PRC), from attacking US assets in the space domain.[1] Yet despite the ubiquity of statements on the "critical" nature of US military and intelligence satellites to "the modern American way of war," or others detailing the specifics of how satellites support the warfighter in other domains, the ways in which space assets can directly affect military operations and American integrated deterrence writ large are rarely addressed.[2] Thus, what remains noticeably absent from such discussions as well as discussions on cross-domain deterrence—and from space deterrence literature as a whole—are detailed accounts of what deterrent effects space assets produce themselves.

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1. Krista Langeland and Derek Grossman, *Tailoring Deterrence for China in Space* (Santa Monica, CA: RAND Corporation, 2021), https://www.rand.org/; Stephen J. Flanagan et al., *A Framework of Deterrence in Space Operations* (Santa Monica, CA: RAND Corporation, 2023), https://www.rand.org/; Steve Lambakis, *A Guide for Thinking about Space Deterrence and China* (Fairfax, VA: National Institute Press, 2019), https://www.nipp.org/; and Scott Pace, "A U.S. Perspective on Deterrence and Geopolitics in Space," *Space Policy* 66 (November 2023), https://doi.org/.

2. Michael P. Gleason and Peter L. Hays, "Getting the Most Deterrent Value from U.S. Space Forces," in *Space Agenda 2021: Informing the Future of Space* (El Segundo, CA: Aerospace Corporation, October 2020), 55, https://csps.aerospace.org/; and Nathaniel A. Peace, "Space Denial: A Deterrence Strategy," *Joint Force Quarterly* 111, no. 4 (October 30, 2023), https://ndupress.ndu.edu/.

This significant gap in the literature indicates the potential of military strategists to propagate perspectives in which space assets are viewed myopically as liabilities in need of the protection of deterrence rather than as assets with powerful deterrent properties of their own. In reality, space assets fall on both sides of this metaphorical deterrence moon—they are simultaneously both vulnerable liabilities and powerful deterrents themselves.

This article examines how the United States can bolster its efforts to deter its "pacing challenge," the PRC, from offensive actions in nonspace domains, using American space capabilities.[3] Borrowing from the US Space Force mission statement—which is to "secure our Nation's interests in, from, and to space"—this article will subsequently refer to the act of using deterrence to protect American satellites and space assets specifically from attacks in the space domain as deterrence in space, and the act of using American space assets to deter offensive actions in nonspace domains as deterrence from space.[4]

Given the rapid rise of PRC military capabilities and ambitions, the United States must integrate use of a deterrence-from-space framework into its operational and strategic mode of thinking.[5] This article focuses on two US space capabilities as examples of the unique deterrence capabilities elucidated by a deterrence-from-space framework: orbital-class rocket resupply and space-based solar power. The United States must continue to invest in, develop, evaluate, and eventually deploy these technologies to maximize its potential deterrent effect with respect to China.

Theoretical Foundations

Deterrence from space differs from deterrence in space by reframing the positionality of space assets from vulnerable liabilities to deterrent assets. Deterrence from space is also wider in scope and focuses on using space assets to deter aggression and attacks in all nonspace domains, whereas deterrence in space solely focuses on deterring attacks specifically within the space domain.[6]

Deterrence from space, grounded in traditional deterrence theory, prioritizes the following distinctions. First, it is important to distinguish between the two forms of strategic coercion—namely, deterrence and compellence.[7] States certainly could compel from space by continuously and actively inflicting forceful punishment on an adversary using space

3. Lloyd J. Austin III, *National Defense Strategy of the United States of America* (Washington, DC: Department of Defense [DoD], 2022).

4. "United States Space Force Mission," US Space Force, accessed December 11, 2023, https://www.spaceforce.mil/; Langeland and Grossman, *Tailoring Deterrence*; Pace, *U.S. Perspective*; and Gregory D. Miller, "Preventing War with a Warfighting Domain: Nuclear Deterrence Lessons for Space," *Astropolitics* 19, no. 1–2 (May 4, 2021), https://doi.org/.

5. Dean Cheng, *Cyber Dragon: Inside China's Information Warfare and Cyber Operations*, The Changing Face of War (Santa Barbara, CA: Praeger Security International, 2017); and Austin, *National Defense Strategy*.

6. Miller, "Preventing War."

7. Michael J. Mazarr, *Understanding Deterrence* (Santa Monica, CA: RAND Corporation, April 19, 2019), 2, https://doi.org/.

assets until the adversary stops acting in a specified way. Given the sophisticated nature of US space capabilities, compellence from space is likely already theoretically possible. Yet due to other difficulties, such as the need for a carefully calibrated time frame and credibility roadblocks that plague all conceptions of compellence, this article focuses only on the concept of deterrence from space.[8] Deterrence from space is conceptually bound to threats of force held in reserve, derived from space assets, to prevent some specified adversarial action in any nonspace domain.[9]

Acknowledging the further distinction between deterrence by denial and deterrence by punishment from space, this article will focus on deterrence by denial from space. This can be conceptualized as the use of space assets to deny an adversary the ability to achieve some offensive end in a nonspace domain by imposing sufficient costs such that the offensive action is not worth pursuing in the first place.[10]

Integrated Deterrence

Deterrence from space fits perfectly within the notion of integrated deterrence outlined in the 2022 *National Defense Strategy*, whereby the United States first aims to deny adversaries opportunities in which the costs do not outweigh the advantages of attacking.[11] Integrated deterrence "seeks to integrate all tools of national power across domains, geography, and spectrum of conflict, while working with allies and partners."[12]

Deterrence by denial from space complements this framework by emphasizing the deterrent effects of capabilities the United States already employs. Some of these capabilities include GPS-provided position, navigation, and timing capabilities, which bolster precision-weapons targeting; satellite-based military communications, which enhance military responsiveness, readiness, and coordination; and space-based nuclear command and control systems, which underpin America's nuclear capabilities.[13]

These current space capabilities when viewed with a deterrence-from-space framework become key contributors to the effectiveness of general US strategic efforts to deter by denial due to the ways in which they increase the cost of offensive adversarial actions in all domains. In addition to highlighting the deterrence-by-denial effects generated by current US space assets, the deterrence-from-space framework elucidates deterrence-by-denial properties of space assets, such as orbital-class rocket resupply and space-based solar power, that otherwise would not be considered deterrents.

8. Thomas Schelling, *Arms and Influence*, Veritas Paperback ed. (New Haven, CT: Yale University Press, 2020), 69–78.

9. Miller, "Preventing War"; and Schelling.

10. Austin, *National Defense Strategy*; and Lambakis, *Guide*.

11. Austin; and Langeland and Grossman, *Tailoring Deterrence*.

12. Stacie Pettyjohn and Becca Wasser, *No I in Team* (Washington, DC: Center for New American Security, December 14, 2022), executive summary, https://www.cnas.org/.

13. Langeland and Grossman, *Tailoring Deterrence*; and Lambakis, *Guide*.

Finally, it might be argued that devoting more attention to deterrence from space is not necessary because the use of American space assets as deterrents is implied by the United States' reliance on cross-domain punishment threats—that "deterrence is just deterrence."[14] Yet this is not the case. One of the pillars of effective deterrence in any domain is clear communication.[15] Without effective communication that results in one's adversaries understanding and believing one's deterrent threats, adversaries will not be deterred.[16]

Given the current literature and official government documents' lack of discussion about deterrence from space, the United States may not be clearly communicating its ability and intention to use space-based capabilities as deterrents beyond their use in support of the warfighter. Importantly, proper communication regarding this additional frame of reference for space deterrence will increase both the likelihood that US policymakers and military officials view space assets as having their own inherent deterrent effects and the likelihood that the PRC understands and internalizes this deterrence potential.[17]

A View from China

To evaluate the credibility of US deterrence from space vis-à-vis China, a baseline understanding of China's conceptions of space deterrence is necessary. It is important to delineate the difference between Western theoretical conceptions of deterrence from the nearest Chinese concept, 威慑 or *weishe*.[18] The basis of the Western concept of deterrence, as understood by the United States, is the idea of dissuasion—that is, that threats of force are used in order to prevent an adversary from certain action and will only be carried out if the adversary performs this action. The Chinese concept of *weishe*, on the other hand, can best be understood as strategic coercion as defined by Thomas Schelling. Western strategic ideas of both dissuasion and persuasion are included in this concept; therefore, *weishe* encompasses both Western ideas of deterrence and compellence.[19]

Another meaningful contrast between these Western and Chinese concepts is whether they are considered a means to larger ends or an end in and of themselves. In US military

14. Austin, *National Defense Strategy*; and Nicole Petrucci, "Building Space into Multi-Domain Deterrence Strategy," *Angle of Attack: A Journal of Airpower Strategy* [blog], December 1, 2018, https://www.airpowerstrategy/.

15. Bryan Boyce, "Twenty-first Century Deterrence in the Space War-Fighting Domain: Not Your Father's Century, Deterrence, or Domain," *Air & Space Power Journal* 33, no. 1 (2019), https://www.airuniversity.af.edu/.

16. Boyce.

17. Austin, *National Defense Strategy*.

18. Dean Cheng, "Chinese Views on Deterrence," *Joint Force Quarterly* 60, no. 1 (2011), https://ndupress.ndu.edu/; Cheng, "An Overview of Chinese Thinking About Deterrence," in *NL ARMS Netherlands Annual Review of Military Studies 2020: Deterrence in the 21st Century—Insights from Theory and Practice*, ed. Frans Osinga and Tim Sweijs (Hague: T. M. C. Asser Press, 2020), 177–200, https://doi.org/; and James Scouras, Edward Smyth, and Thomas Mahnken, *Cross-Domain Deterrence in US-China Strategy: Workshop Proceedings* (Laurel, MD: Johns Hopkins University Applied Physics Laboratory, 2017), https://www.jhuapl.edu/.

19. Cheng, "Chinese Views"; Cheng, "Overview"; Scouras, Smyth, and Mahnken; and Schelling, *Arms and Influence*, 4–5, 69–78.

strategy, preventing adversaries from acting is a goal worth pursuing for its own sake. In PRC military strategy, however, *weishe* is a means of achieving other broader strategic goals; mainly, it is a method of psychological warfare that has the power to constrain the actions of adversaries. In other words, *weishe* is not to be pursued—or, more representative of Chinese strategy, used—for its own sake, but only to force adversaries to submit to strategic objectives.[20]

These unique characteristics of *weishe* directly affect how the PRC applies this concept to space to create the concept of 空间威慑 or *kongjian* [space] *weishe*.[21] This concept entails using "space forces and capabilities to deter or coerce an opponent, preventing the outbreak of conflict, or limiting its extent should conflict occur."[22] Unlike the United States, whose concern about establishing deterrence in space stems from its own dependence on space assets, China is concerned with operationalizing *kongjian weishe,* which stems from its recognition that the United States is both dependent on and vulnerable in space.[23] Thus, if one had to choose, it would be most accurate to compare *kongjian weishe* with the concepts of deterrence—and compellence—from space as opposed to in space. This is because the PRC is not particularly focused on preventing adversaries from attacking its satellites or acting in space, but rather on employing space systems, which give it the ability to influence the perceptions, and thus behavior, of adversaries in all domains, but particularly nonspace domains.[24]

Thus, China's own theory of *kongjian weishe* is likely evidence of the credibility of a US deterrence-from-space posture with regard to China. Given that the PRC already values its space assets primarily for the strategic and holistic effects they produce in all nonspace domains and the fact deterrence from space aims to use space assets in largely the same way, it seems highly likely the PRC will find US deterrence from space credible.[25] This is because deterrence from space simply asks the PRC to believe its own words that *kongjian weishe* "has a great deterrent effect on the enemy."[26] Ultimately, if the PRC believes that it can credibly achieve such a coercive effect using *kongjian weishe*, it is reasonable to conclude that the PRC will similarly find its closest Western conception, deterrence from space, to be equally credible and effective.[27]

While the similarities between *kongjian weishe* and deterrence from space enhance the credibility of US deterrence from space efforts vis-à-vis China, they also provide for one area of potential escalatory misunderstanding. Given the tendency of states to project their

20. Cheng, "Chinese Views"; and "Overview."
21. Cheng, "Overview"; and *Cyber Dragon*.
22. Cheng, "Overview."
23. Cheng.
24. Cheng, "Overview"; and *Cyber Dragon*.
25. Cheng.
26. *In Their Own Words: Science of Military Strategy 2020* (Montgomery, AL: China Aerospace Studies Institute, January 2020), 130, https://www.airuniversity.af.edu/.
27. *Their Own Words*, 130.

own behaviors and beliefs onto their adversaries, US deterrence from space could be mistakenly viewed by China as a means of compellence.[28] China's use of a singular concept for both compellence and deterrence has the potential to blind the PRC to this nuance in US thinking. Evidence of such misperceptions already exists. Analysis of PRC perceptions of US actions in space find the PRC tends to interpret US deterrent efforts in space as being aggressive or coercive.[29]

While this presents the possibility of unintended escalation due to misperception, the advantages associated with US employment of a deterrence-from-space framework outweigh these potential risks. Not only does deterrence from space enhance integrated deterrence by increasing the effectiveness of deterrence by denial, but also past US actions in space aimed at clarifying its intentions have generally been viewed as disingenuous by China.[30] Thus, refraining from implementing a deterrence-from-space framework would rob the United States of deterrence advantages without assuaging PRC misperceptions.

Deterring China from Space

To successfully determine how the United States might leverage its space assets to deter the PRC from space, one first must understand how China calculates the cost-benefit analysis of taking offensive actions as well as what specific interests the United States must credibly hold under threat for China to be deterred. While an exhaustive discussion of China's interests is outside the scope of this paper, one PRC vital interest seems particularly susceptible to US deterrence from space: military-balance/cost-benefit calculations.

China's main interest in achieving either an equilibrium balance of power with the United States or, from its perspective, preferably an imbalance in its favor, stems from long-standing designs on becoming the regional hegemonic power in the Asia-Pacific region and achieving "reunification" with Taiwan.[31] As such, the PRC is extremely concerned with the balance of military power in the region.[32] Importantly, China seems to rely on calculations of military balance as part of its determination for the use of force to invade Taiwan, refraining from invading so long as it believes the likelihood of defeat is higher than that of success.[33]

Thus, the PRC's military-balance cost-benefit calculation is susceptible to targeting by US deterrence from space. The United States should do so by investing in, developing, and eventually deploying orbital-class rocket resupply and robust space-based solar power.

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28. Alexis A. Blanc et al., *Chinese and Russian Perceptions of and Responses to U.S. Military Activities in the Space Domain* (Santa Monica, CA: RAND Corporation, October 11, 2022), https://www.rand.org/.

29. Blanc et al.

30. Blanc et al.

31. Lindsay Maizland, "China's Modernizing Military," Council on Foreign Relations, updated February 5, 2020, https://www.cfr.org/; and Jared M. McKinney and Peter Harris, "Broken Nest: Deterring China from Invading Taiwan," *Parameters* 51, no. 4 (November 17, 2021), https://press.armywarcollege.edu/.

32. McKinney and Harris; Maizland; and Cheng, *Cyber Dragon*.

33. McKinney and Harris.

Orbital-Class Rocket Resupply

The United States can enhance the effectiveness of its overall deterrence posture with regard to China by investing in and developing orbital-class rocket resupply as a deterrence-from-space capability. Orbital-class rocket resupply capability entails the use of rocket-powered spacecraft to rapidly transport large amounts of cargo, or possibly even people, from one point on the globe to any other, via flights that reach just above the atmosphere of Earth and into space—just over 100 kilometers in altitude.[34] Such flights require the use of orbital class rockets, such as SpaceX's Starship or other similarly sized orbital platforms.[35]

While the time such capabilities will spend in the space domain is minimal, their development is inextricably linked to the development of space domain technologies and research and development, and therefore can only be viewed as space capabilities.[36] While this technology is still years away from being operational, current estimates suggest such a capability would be able to transport the equivalent cargo payload of a US Air Force C-17 cargo plane—about 170,000 pounds—anywhere in the world in less than an hour's time, with even larger payloads likely possible as the technology progresses.[37]

While US Transportation Command has already invested in studies and demonstration contracts with private companies such as SpaceX and Blue Origin, the Department of Defense needs to remain steadfast in its pursuit and development of these technologies.[38] The Pentagon's efforts regarding orbital-class rocket resupply technologies have been criticized mainly for being either too provisional or, most cogently, for being technologically too nascent to warrant investment.[39] Yet given this technology's potential unmatched ability to alter China's military balance calculations in contingencies in the Asia-Pacific region, the nascent stage of this technology offers a powerful argument for more substantial investment in its development.

Currently, US deterrent threats to respond with force against either a PRC invasion of Taiwan or its use of military force in other Asia-Pacific contingencies face an enormous credibility problem due to the extreme logistical difficulty of supporting and deploying

34. US Transportation Command (USTRANSCOM) Public Affairs, "Rocket Cargo Delivery Gets Big Boost," press release, June 7, 2021, https://www.ustranscom.mil/; Theresa Hitchens, "Starship Troopers? TRANSCOM-SpaceX Accord Raises Policy Eyebrows," Breaking Defense, October 8, 2020, https://breakingdefense.com/; and Sandra Erwin, "SpaceX Wins $102 Million Air Force Contract to Demonstrate Technologies for Point-to-Point Space Transportation," *SpaceNews*, January 19, 2022, https://spacenews.com/.

35. Von P. H. Fernandes et al., "The World in 90 Minutes or Less: Rocket Logistics and Future Military Operations," *Campaigning: The Journal of the Joint Forces Staff College* (October 13, 2022), https://jfsc.ndu.edu/.

36. Fernandes et al.

37. Hitchens, "Starship Troopers?"; and "C-17 Globemaster III," Military.com, accessed December 12, 2023, https://www.military.com/.

38. "United States Transportation Command," USTRANSCOM (website), accessed December 12, 2023, https://www.ustranscom.mil/; Hitchens; and Erwin, "SpaceX."

39. Hitchens.

US troops so far away from the American homeland.[40] This so-called tyranny of distance includes the vast surface area of the Pacific Ocean, which poses fuel sufficiency issues for cargo flights, the immense lead times needed to move sufficient supplies and troops into the Asia-Pacific theater, and the extreme scale of such efforts.[41] These logistical nightmares undermine even integrated deterrence's most sincere threats to respond with force to China's offensive actions, based solely on the fact that US follow-through might not be feasible within a reasonable time frame.[42] The PRC weighs this US inability for rapid response into its calculations of the regional military balance and thus ultimately into whether to find American deterrent threats sufficiently plausible.[43]

A fully functional orbital-class rocket resupply capability would resolve these logistical infeasibilities, affirming US deterrence concerning China's aims regarding Taiwan. The ability to move cargo planes'-worth of military supplies and possibly even troops from the American homeland or other military bases around the globe to the Asia-Pacific theater in under an hour would strengthen deterrence by denial by increasing the likelihood that the PRC would deem offensive actions inadvisable in the first place. Moreover, this capability would also strengthen US deterrence by punishment by increasing the rapidity with which the United States could carry out its deterrent threats if needed.[44]

The capability of orbital-class rocket resupply is still likely decades away from being mature enough to reach production or integration into US military operations.[45] The lack of test flights, uncertainties about how cargo would need to be stored to successfully survive flights, and concerns about the feasibility of deploying intricate and temperamental technologies such as rockets at an effective scale all pose serious challenges to the realization and implementation of orbital-class rocket resupply as an effective deterrent from space.[46] Given the ability of such a technology to solve an otherwise overwhelming deterrence problem for the United States, however, the Department of Defense and senior political leaders should continue to invest in and develop orbital-class rocket resupply.

Notably, orbital-class rocket resupply demonstrates the importance of using multiple conceptual frames when discussing the relationship between deterrence and space. Given this capability's lack of deterrent effect specifically within the space domain, it is not and never would be mentioned in the context of deterrence in space. Yet with the conceptual framework of deterrence from space, its potential deterrent effect becomes obvious. Even if future US leaders find the use of orbital-class rocket resupply at scale to be infeasible or cost ineffective, integrated deterrence can only be strengthened by seriously evaluating

40. McKinney and Harris, "Broken Nest"; and Maximillian K. Bremer and Kelly A. Grieco, "The Four Tyrannies of Logistical Deterrence," Stimson Center, November 8, 2023, https://www.stimson.org/.

41. Bremer and Grieco.

42. McKinney and Harris, "Broken Nest"; and Bremer and Grieco.

43. McKinney and Harris.

44. McKinney and Harris; and Bremer and Grieco, "Four Tyrannies."

45. Fernandes et al., "World."

46. Fernandes et al.

this capability and all others whose deterrent effects only become apparent within a deterrence-from-space framework.

Space-Based Solar Power

Another deterrence-from-space solution that can increase the overall effectiveness of US integrated deterrence vis-à-vis China, is space-based solar power. Space-based solar power is created using satellites that transform solar energy into microwaves, which are then wirelessly beamed down to Earth to be used as power.[47] This space-based technology can bolster US efforts to deter PRC coercive military actions short of war in the Asia-Pacific region.

Implicit in the conception of *weishe* is China's reliance on coercive military measures short of war, sometimes referred to as irregular warfare.[48] The PRC's use of irregular warfare measures has recently come to the forefront of global news. For example, in 2023, the Chinese navy blocked Philippine access to one of the island nation's own shoals, and it conducted exercises that same year simulating a naval blockade of Taiwan.[49] China's tactic of using naval blockades, designed to either cut off access/trade to a given island to force an adversary to submit, is hard for US deterrent threats to prevent.[50] The difficulty of deterring such tactics and other irregular warfare measures lies in the fact that threatening to respond with force is much less credible when the initial provocation does not constitute an act of war.[51]

While the PRC has not attempted to blockade US Asia-Pacific Allies and partners, such as Japan and Taiwan, the ineffectiveness of traditional deterrent threats in preventing this type of coercion suggests China could attempt such blockades, despite the logistical challenges. Importantly, both Japan and Taiwan are particularly vulnerable to coercion via blockade since each relies on imports to provide over 90 percent of their energy needs.[52] Employing an irregular warfare tactic vastly reduces the likelihood of American military retaliation while also providing the PRC with significant leverage with which to gain political concessions. This not only exemplifies *weishe* in its purest form, but also conforms to the Chinese strategic interest of maintaining a favorable military balance.[53]

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47. "Space-Based Solar Power Overview," European Space Agency, August 8, 2022, https://www.esa.int/.

48. Cheng, "Overview"; Cheng, *Cyber Dragon*; and Scouras, Smyth, and Mahnken, *Cross-Domain Deterrence*.

49. Ben Blanchard and Yimou Lee, "China Ends Taiwan Drills after Practising Blockades, Precision Strikes," Reuters, April 10, 2023, https://www.reuters.com/; and Karen Lema and Kay Johnson, "Explainer: Why China, the Philippines Keep Fighting over Tiny Shoal," Reuters, December 11, 2023, https://www.reuters.com/.

50. John J. Klein, *Fight for the Final Frontier: Irregular Warfare in Space* (Annapolis, MD: Naval Institute Press, 2023).

51. Klein.

52. "Japan: Overview," US Energy Information Administration, July 7, 2023, https://www.eia.gov/; and Joseph Webster, "Does Taiwan's Massive Reliance on Energy Imports Put Its Security at Risk?," *New Atlanticist* (blog), Atlantic Council, July 7, 2023, https://www.atlanticcouncil.org/.

53. Klein, *Fight*; McKinney and Harris, "Broken Nest"; and Cheng, "Overview."

Space-based solar, however, has the potential to deprive the PRC of the coercive leverage of blockades by decreasing the dependence of both Taiwan and Japan on energy imports in times of crises. While still in its infancy, space-based solar technology is much further along in development than orbital-class rocket resupply capabilities.[54] Fortunately, even modest projections of the potential power-generation capabilities of space-based solar suggest single satellites would be able to provide two gigawatts of power, enough to continuously power a city of two million people.

Even better, the energy-providing microwaves produced by solar power satellites can be directed anywhere in range that has the requisite power-receiving antennae. This means that whether the United States builds these satellites in collaboration with its Asia-Pacific Allies and partners or builds them for its own in-theater use, in times of crises, the United States could redirect power where needed.[55] In this way, space-based solar power can bolster US integrated deterrence with regard to China by decreasing the chance that PRC blockades would produce their desired coercive effect, thus disincentivizing their use.

While space-based solar power technology is indeed ahead of orbital-class rocket resupply in its development, various technological challenges and feasibility concerns remain. Fully functional systems will not be able to be deployed until the government or industry develops reliable space-debris protection techniques and the government acquires a more substantial understanding of potential environmental or health effects caused by the wireless transmission of power.[56] Perhaps the most critical roadblock to the development of this technology is the expected costs associated with launching the requisite satellite systems into orbit.[57] Despite criticism of its methodology, a recent NASA report determined the cost per kilowatt hour of electricity produced by space-based solar far exceeds that of traditional renewable energy sources.[58]

While such price disparities might make space-based solar infeasible as a renewable energy source, the cost-benefit calculation necessarily changes when such capabilities are viewed as a possible deterrent within a deterrence-from-space framework. With the use of deterrence from space, the value of the potential power provided by this capability necessarily exceeds the value of traditional and standard power generation due to its potential deterrent effect against China's coercion.

Fielding capable and robust space-based solar satellites might not be enough to deter China from employing irregular warfare tactics, such as blockades, on its own. Yet, it most

54. Peggy Hollinger, "How to Make Space-Based Solar Power a Reality," *Financial Times*, October 17, 2023, https://www.ft.com/; and Robert Lea, "Scientists Beam Solar Power to Earth from Space for 1st Time Ever," Space.com, June 12, 2023, https://www.space.com/.

55. Hollinger.

56. Rajini Karduri et al., "Exploring the Viability of Space-Based Solar Power," *International Journal of Advanced Research in Innovative Discoveries in Engineering and Applications* 4, no. 2 (April 27, 2019), http://dx.doi.org/.

57. Jeff Foust, "NASA Report Offers Pessimistic Take on Space-Based Solar Power," *SpaceNews*, January 19, 2024, https://spacenews.com/.

58. Foust.

certainly would be an effective addition to US deterrence-by-denial efforts in the Asia-Pacific region as it would negatively alter the PRC's cost-benefit calculations regarding the use of such coercive behavior. Using the framework of deterrence from space, the United States should continue to invest in, research, and develop space-based solar power.

Conclusion

Careful review of the current literature and theoretical landscape regarding deterrence and space reveals a dangerous US national security gap: a lack of discussion and integration of a deterrence-from-space framework into overall US strategic and deterrence thinking. Deterrence from space, which seeks to leverage US space capabilities to deter offensive actions in all nonspace domains, is theoretically compatible with and complementary to integrated deterrence. Continuing to neglect the theoretical and practical importance of deterrence from space will only detract from the effectiveness of overall US deterrence by leaving potential space-based deterrent capabilities unexplored and unleveraged.

Importantly, the United States must pursue deterrence from space by continuing to invest in, develop, and deploy orbital-class rocket resupply and robust space-based solar power. Now, more than ever, the United States must not be content with leaving one-half of the deterrence moon in darkness. ✈

***Masters of the Air*, season 1, episodes 1 and 2.**

Directed by Cary Joji Fukunaga, written by John Orloff. Aired January 26, 2024, Apple TV+.

Masters of the Air is the third World War II miniseries from Stephen Spielberg, Tom Hanks, and Gary Goetzman, executive producers of *Band of Brothers* (2001) and *The Pacific* (2010). Like the earlier series, this most recent offering is based on a compelling book by a distinguished author, in this case *Masters of the Air: America's Bomber Boys Who Fought the Air War against Nazi Germany* by Donald L. Miller, professor emeritus at Lafayette College and a frequent adviser to film and documentary producers.[1]

Spielberg, Hanks, and Goetzman put Miller's material into the hands of head writer andco-producer John Orloff, best known for having written two episodes of *Band of Brothers*, including "Day of Days," which told of Easy Company's jump into Normandy.[2] Four of the series' nine episodes, including both under review here, were directed by Cary Joji Fukunaga. Fukunaga is an experienced producer and director of both movies and prestige TV, with credits such as the 2021 James Bond film *No Time to Die* and first season of HBO's *True Detective* to his name.[3]

Masters of the Air focuses on the wartime experience of the 100th Bomb Group, a four-squadron B-17 unit based at Thorpe Abbotts airfield in Norfolk. The group at its arrival in the United Kingdom comprised 37 crews of 10 Airmen—a larger pool of dramatis personae than the single infantry company featured in *Band of Brothers*, but still substantially more constrained in both size and scope than *The Battle of Britain* (1969) or *Tora! Tora! Tora!* (1970), two of the best examples of an earlier generation's World War II aviation epics. Confining the story to a relatively small number of individuals is characteristic of Spielberg's approach to historical filmmaking, an approach exemplified in *Empire of the Sun* (1987), *Schindler's List* (1994), and *Saving Private Ryan* (1998).

The two most prominently featured Airmen are Majors Gale Cleven and John Egan, commanders of the 350th and 418th Bomb Squadrons. Known as "Buck" and "Bucky," Cleven and Egan were prewar aviation cadets who became bombardment instructor pilots before their deployment with the 100th Bomb Group to the UK.[4] They are well played here by Austin Butler (a 2022 Academy Award nominee for *Elvis*) and Callum Turner (*The Boys in the Boat*, 2023), who manage to portray Cleven and Egan, respectively, as confident and competent aviators who are nonetheless shaken by the violent intensity of air warfare. "Why didn't you tell me?" asks Cleven after his first sortie, in which three 100th Bomb Group Flying Fortresses were shot down, with a presumed loss of all 30 crewmen.

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1. "Author & Historian Donald L. Miller," Lafayette College, accessed January 31, 2004, https://sites.lafayette.edu/.

2. "John Orloff," IMDb [International Movie Database], accessed January 31, 2024, https://www.imdb.com/.

3. "Cary Joji Fukunaga," IMDb, accessed January 31, 2024, https://www.imdb.com/.

4. "Gale Winston Cleven," American Air Museum in Britain, accessed January 31, 2024, https://www.americanairmuseum.com/; and "John Clarence Egan," American Air Museum, accessed January 31, 2024, https://www.americanairmuseum.com/.

What Egan doesn't say but Fukunaga does show is that maneuvering large formations of heavy bombers in combat conditions can be almost unbearably chaotic. The group struggles to rendezvous over Thorpe Abbots, the lead aircraft aborts for a mechanical problem, the trailing element straggles, and a damaged Fort can't maintain station on the return leg. It is evident that the crews face considerable challenges in simply aviating, navigating, and communicating, well before confronting the rigors of actual air combat. That struggle is also convincingly presented: the flak bursts and German fighters are obviously computer generated, but their size, shape, speed, and relative motion are marvelously rendered. The Playtone-Amblin CGI artists appear to have modeled these scenes on documentary footage, perhaps from the extraordinary 2018 film *The Cold Blue*, compiled from restored stock from William Wyler's 1944 *Memphis Belle*.[5] The flying scenes are so realistically and similarly composed that *Masters of the Air* feels at times like an expansion of *The Cold Blue* universe.

That these first combat missions—the 100th Bomb Group had flown on two diversions a week earlier—are depicted with a clear and unsentimental eye bodes well for the remainder of the series. The producers have gone to some lengths for authentic detail: Egan wears "his trademark sheepskin jacket," the pre-mission brief matches historical records, the crews don parachutes from rows of racks instead of more dramatic sport-styled lockers.[6] The crew coordination is likewise realistic: engine start sequences, checklist usage, and intercom chatter have the right vocabulary and rhythm. Orloff avoids the temptation of inserting exposition into these snippets, choosing instead to let the camera explain the dialogue.

Occasionally, however, he and Fukunaga allow their confidence in the audience to waver, and they reach for the crutch of a voiceover. Two episodes in, the narration is not yet a burden, as it is used infrequently, but it does feel abrupt and unnecessary. The bit about the Norden bombsight in "Part Two," for example, added little, and one can imagine if Spielberg had been behind the camera there would have been no words at all—just a zoomed closeup of the manufacturing label while the bombardier pinned the bombsight into place.

There are a few other distracting conversations, mostly in bars. The opening scene of the first episode in which we are introduced to Cleven, Egan, and their dates is clunky. So, too, is the bar argument between our Masters and their Royal Air Force counterparts, who are dismissive of the US strategy of daylight precision bombing. Such a row might well have taken place between American and British airmen, but this depiction of it and the fight that follows are unconvincing.

These last observations are mere quibbles. The show so far succeeds wonderfully on all counts: it is accurate, believable, and watchable. In technical terms it is the equal, at least, of *Band of Brothers* and *The Pacific*, and the dialogue and acting to this point far exceed the latter.

5. "*The Cold Blue*," IMDb, accessed January 31, 2024, https://www.imdb.com/.
6. "John Clarence Egan."

If the series is able to maintain the momentum gathered in this taxi and takeoff phase, it should have no trouble finding its strategic target.

Dr. Stephen L. Renner, Colonel, USAF, Retired

***Masters of the Air*, season 1, episode 3.**

Directed by Cary Joji Fukunaga, written by John Orloff. Aired February 1, 2024, Apple TV+.

Having recently rewatched *Twelve O' Clock High* (1949)—the stark depiction of the immense burden of commanding in combat—I found it jarring to see the first trailer for *Masters of the Air*. Whereas *Twelve O' Clock High* was shot in black and white and features more scenes in an office than in the air, *Masters of the Air*'s trailer is evocatively colorful and brash. Still, both—to some extent—delve into the same territory of the interdependent struggle to balance a leader's responsibility to the mission as well as to their crew members. Both also focus on so-called "hard luck units."[1] In addition to pointing out some differences and similarities between the two shows, this review above all will help contextualize *Masters of the Air* given the disappointingly limited background information the show has provided so far.

Masters of the Air begins in May 1943, almost a year after the Eighth Air Force's first mission. *Twelve O' Clock High,* by contrast, starts earlier in the war. Indeed, the authors of the novel on which the movie was based had been with the Eighth Air Force since its arrival in England in 1942. They had thus witnessed one of the darkest periods of the Eighth's history in the winter and spring of 1943 as the organization began bombing Germany. Without the long-range fighters that greatly eased the bombers' missions in 1944, it was statistically impossible for crews to finish their tours at this point in the war.

It was also difficult for the Eighth's leadership, with some advocates of daylight bombing desperate enough to consider the need to perhaps switch to nighttime bombing.[2] *Masters of the Air*'s second episode briefly touches on this tension between British and American bomber crews. But the fight that breaks out between the two nations' crews has little to do with Airmen having imbibed their leaders' doctrine but rather more to do with the human costs that the American crews had to pay.[3]

The key tension that has not significantly emerged yet in *Masters of the Air* is that between the crews and the Eighth Air Force's highest-ranking and, arguably, its most dogmatic leaders.[4] As one Airman wrote critically and retrospectively of the Army Air Forces'

1. See John T. Correll, "The Real Twelve O' Clock High," *Air & Space Forces Magazine,* January 1, 2011, https://www.airandspaceforces.com/.

2. Heather Venable, "Rescuing a General: General Haywood 'Possum' Hansell and the Burden of Command," *Journal of Military History* 84, no. 2 (2020): 502–503.

3. See, for example, Richard Overy, *The Bombers and the Bombed: Allied Air War over Europe, 1940–1945* (New York: Penguin Books, 2015), 78.

4. See Tami Davis Biddle, *Rhetoric and Reality in Air Warfare: The Evolution of British and American Ideas about Strategic Bombing, 1914–1945* (Princeton: Princeton University Press, 2009), 6–7.

mindset, "Washington was engaging in a numbers game similar to the one that was later used in the Vietnam War" resting on "grossly exaggerated reports."[5] This critique receives some credence from the correspondence of Army Air Forces General Ira Eaker. Eaker wrote in the middle of March 1943 that the Eighth Air Force had successfully completed its "daylight high-level precision bombing experiment." Nothing could be further from the truth, especially without the arrival of long-range escort fighters. Instead, the fulfillment of missions required what Eaker dubbed the "self-sacrifice" of bomber crews. Tragically, though, the targeting of submarine pens that played such an important role in this phase of the war—the subject of episode 2—was a waste. They were so well-reinforced by concrete that even a fortuitously precise hit would be unsuccessful.[6]

These human costs had taken a toll on the morale of crew members and some leaders, including two colonels who returned to the United States from England in April 1943, supposedly having lost their "combat spirit." Hearing of this, Eaker insisted that each member of the Eighth Air Force be "fully imbued with the offensive spirit" and be willing "to pay any cost and at all odds."[7] This was the mindset of Air Force generals leading into episode 3. Having finally built up an air fleet, Air Force leadership would now proceed to burn through it, determined to prove itself to the other services and its ideas to itself and the Royal Air Force.

This notion of "maximum effort" emerges in both *Twelve O' Clock High* and *Masters of the Air,* as epitomized by the latter in episode 3's raid on Schweinfurt and Regensburg. As Colonel Neil Harding (played by James Murray) explains in this episode, a "maximum effort" attack consisted of 12 bombers in August 1942, but now the Americans could launch 370 bombers. Putting this number in perspective, however, shows how much maturing the Eighth Air Force still had to do. The previous month, the British had launched 791 bombers during Operation Gomorrah, the infamous attack on Hamburg, Germany.[8]

Episode 3 also marks a key shift in the air war's targeting. In episode 2, the Eighth Air Force struck joint targets. The attack on a German submarine pen in Norway supports the Battle of the Atlantic, so critical in keeping sea lines open between the United States and Great Britain. Schweinfurt and Regensburg, by contrast, epitomize the types of industrial bottleneck targets that pre-war air planners had envisioned at Maxwell Air Force Base's Air Corps Tactical School. Schweinfurt had a key ball bearings factory that planners hoped could grind fighter production to a halt. US air planners had latched onto the

5. Ralph H. Nutter, *With the Possum and the Eagle: The Memoir of a Navigator's War over Germany and Japan* (Denton: University of North Texas Press, 2005), 120.

6. General Ira Eaker to Commanding General, VIII Bomber Command, March 24, 1943, Papers of Ira C. Eaker, Box I:19, Library of Congress; and also see Barrett Tillman, "Hard Targets," *Air Force Magazine,* September 2015, 80–84; https://www.airandspaceforces.com/.

7. Major General Ira C. Eaker to Commanding General, Fighter Command, April 21, 1943, Papers of Ira C. Eaker, Box I:19, Library of Congress.

8. John Curatola, "Operation Gomorrah: The First of the Firestorms," National World War II Museum, July 10, 2023, https://www.nationalww2museum.org/; and see Overy, *Bombers,* 167.

idea of bottleneck targets after noting how a flood of a Pennsylvania factory had temporarily shut down aircraft production because the factory was the only one to produce an unusual spring required in propellers.[9]

To obtain as much surprise as possible and prevent the enemy to concentrate forces, planners envisioned all the bombers flying the same course for both targets, only breaking into two groups at the last possible moment. Those bombers heading for Regensburg would, in theory, receive the most attention by the Germans, thus facilitating the bombers headed to Schweinfurt. Leaving Regensburg, bombers would fly south to African airfields to avoid having to face German fighters a second time.

Equipped with B-17Fs with so-called "Tokyo tanks," aircraft bound for Regensburg carried an extra 1,080 gallons of fuel. But the fuel came at a cost. Because the aircraft drew on the Tokyo tanks first, the aircraft easily caught fire if hit. By contrast, the Schweinfurt bombers would have to bear the full force of German attention.[10]

Some key problems resulted from the Americans seeking to have a maximum effort without having conserved the required mass to effectively destroy a target. Lacking sizeable-enough weapon loads or aircraft numbers to destroy the factory, they ended up destroying what could be fixed relatively quickly.[11] Airpower zealots might proclaim that Regensburg had been "literally wiped off the map," and a bomber crew member in episode 3 does excitedly claim the factory to be "gone." But hindsight would not support such proclamations.[12] Losing as many bombers in one day as the Eighth Air Force had in the previous six months, moreover, meant that any destruction that had occurred could not be followed up on until October.[13]

More importantly, the problem with this plan was simple: it required all the pieces to fall in place. The literal fog of war—in this case caused by English weather—had something to say about a plan depending on precise timing, breaking up the synchronized plan into two disparate groupings, allowing German fighters to attack both.[14]

One historian has retrospectively described this plan as so complex as to be "all but overwhelming."[15] It is difficult to ascertain exactly what message *Masters of the Air's* screenwriters meant to convey regarding the mission's planning. They have Harding proudly proclaiming the mission to be the "biggest armada in air history," albeit incorrectly, as the British had flown more bombers the previous month. Harding also intones, "The mighty Eighth has a plan" consisting of a "three-punch combo" in which "timing

9. Stephen Budiansky, *Air Power: The Men, Machines, and Ideas that Revolutionized War, from Kitty Hawk to Iraq* (New York: Penguin, 2005).

10. Donald L. Miller, *Masters of the Air: America's Bomber Boys Who Fought the Air War against Nazi Germany* (New York: Simon & Schuster, 2007), 195.

11. Miller, 200, 192.

12. Lieutenant General Harold George, qtd. in Miller, 200.

13. Miller, 201.

14. Ed Jablonski, *Double Strike: The Epic Air Raids on Regensburg-Schweinfurt, August 17* (New York: Doubleday, 1974).

15. Jablonski, 36.

will be essential." Unless the writers expect viewers to home in on the importance of timing, we must perhaps wait to see the evolving messages as the series continues to release new episodes.

In the meantime, it is enough to return to *Twelve O' Clock High* and *Masters of the Air*. The former focuses most on the burden of command and thus features far more glimpses into the mental anguish of those responsible for serving the mission first and foremost. By contrast, *Masters of the Air* focuses much more on the men who must carry out the mission. As such, episode 3 fittingly concludes with badly-battered bombers and their bloodied crews finding themselves with only each other as they observe the setting sun over the Algerian desert.

Heather P. Venable, PhD

***Masters of the Air*, season 1, episode 4**.

Directed by Cary Joji Fukunaga, written by John Orloff. Aired February 9, 2024, Apple TV+.

By this episode, it seems the catch phrase of Major Gale "Buck" Cleven (played by Austin Butler), "Don't count on it," applies to almost any situation members of the 100th find themselves in. Nothing is going to plan, the losses are adding up, and positive outcomes are difficult to discern. Yet, there are constants that buoy all the crew involved in proving the efficacy of daylight strategic bombardment: support from loved ones back home, camaraderie formed from bonds strengthened in combat, and commitments to the triumph of good over evil.

Episode 4 shifts from the difficulty of combat at 25,000 feet to the commitments and ties that bind those determined to make a difference in the vast effort of World War II. The determination and efforts of folks who are not on the front lines are this episode's subject—women, the underground resistance, support troops, and the displaced.

Although barred from combat, women played a huge role in Allied victory. Liberated to a degree from domestic roles, they took jobs in factories to produce the instruments of victory while men went to fight. For other women, the opportunity to travel and get closer to the action drew them to service in organizations such as the Red Cross. Glimpses of these Doughnut Dollies—largely nicknamed by Katherine "Tattie" Spaatz, active Red Cross volunteer and daughter of Twelfth Air Force Commander Lieutenant General Carl A. Spaatz—came in previous episodes.[1]

Motivated by a desire to both help with the war effort and see the world, Helen (Emma Canning) is the living embodiment of the "girl next door" back home—dispensing coffee, doughnuts, and smiles to 100th Bomb Group members in East Anglia.[2] At a group

1. See David R. Mets, *Master of Airpower: General Carl A. Spaatz* (Novato, CA: Presidio Press, 1997), 170, 178–179.

2. See Kara Dixon Vuic, *The Girls Next Door: Bringing the Home Front to the Front Lines* (Cambridge, MA: Harvard University Press, 2019), ch. 2 and 3.

dance, she catches the eye of replacement pilot Lieutenant Herbert Nash (Laurie Davidson). Nash seems interested in her as more than a reminder from back home, while Helen struggles with maintaining her professional role over a more romantic one. When Nash is later lost in combat, Helen must deal with the shock of loss that service members confront directly. Although Helen fills a role as a morale builder who ensures the crews see a pretty face before they go into combat, the independence and freedom from societal norms that come with uniformed Red Cross service offer her scant protection from the direct pain of loss.

Following the Regensburg-Schweinfurt double raid in North Africa, bombardier Captain James Douglass (Elliot Warren) also seeks female support while composing a letter that conveys his nostalgia for the comforts of home and family, amid the long hours of training and combat far from home. This segues to Thorpe Abbotts, where the crew of Captain Glenn Dye (George Webster) returns from their mission. They are the first crew of the 100th to complete 25 missions and earn a trip home from the war. Dye's return temporarily elevates his English girlfriend, Lil (Nancy Farino), from a prop to a more prominent position as she apprehensively scans the skies as well. That night, Dye and his compatriots are feted with a celebration that serves as an introduction for a number of replacement aircrew—led by Lieutenant Robert "Rosie" Rosenthal (Nate Mann)—who seek acceptance from both senior leaders and experienced crews while contemplating the event's significance. The men account for the losses, with only 12 of the original 35 crews that established the 100th Bomb Group in England remaining after three months of combat. In reality, Dye's crew was the only crew of the original 35 that completed a 25-mission tour.[3]

Commander Colonel Neil "Chick" Harding (James Murray) bristles at the suggestion from the medical staff that his unit is "flak-happy" and needs some time at a rest house to deal with the stress of combat. Harding's view here seems counter to the historical view of the Eighth Air Force leadership and most aircrew. Keeping morale high and aircrew motivated were important to the medical staff and most commanders, so leave and passes were fairly liberal, and time in rest and recreation facilities was quite common.

Major John "Bucky" Egan (Callum Turner) takes Cleven's advice for an extended leave in London and is soon in a Polish restaurant/club in Hammersmith enjoying shots and the company of Paulina (Joanna Kulig), the wife of a Polish Air Force pilot. Flying, marital status, dancing, and sex are the topics, not atypical for American aircrew in English towns and cities, especially London.[4] There is even a brief mention of the famed Piccadilly Commandos, the army of prostitutes who plied their trade in London during

3. Harry H. Crosby, *A Wing and a Prayer: The "Bloody 100th" Bomb Group of the U.S. Eighth Air Force in Action over Europe in World War II* (New York: Harper Paperbacks, 1993), 131.

4. See, for example, Juliet Gardiner, *"Overpaid, Oversexed, and Over Here": The American GI in World War II Britain* (New York: Canopy Books, 1992); Robert Morgan with Ron Powers, *The Man Who Flew the Memphis Belle: Memoir of a WWII Bomber Pilot* (New York: New American Library, 2011), 138–39; and Crosby, *Wing*, 305–309.

the war.[5] Paulina later relates that her husband stayed to fight the invading Germans while she evacuated and she is unsure if he is a prisoner or dead in a Silesian potato field.

Ultimately, Egan and Paulina spend the night together. As London is bombed around them, Egan becomes mesmerized by the Luftwaffe raid and confesses that he has never seen the "business end" of what he does. Paulina asserts that the Germans deserve whatever violence and destruction can be delivered to them. The next day, she declares her heart cannot lose another pilot after Egan tries to entice her to spend the day with him. Their story arc details how different people are affected by the chaos of war, seeking escape and respite for many varied reasons.

Meanwhile, the ripples from Regensburg-Schweinfurt radiate further as Sergeant William Quinn (Kai Alexander) opts for passage to freedom through the resistance network. He meets up with fellow crewman Sergeant Charles Bailey (Bailey Brook) and another Airman, Bob, in a Belgian café. Dour members of the resistance interrogate them, demanding verbal and written answers. The three crewmen, accompanied by two Belgians, move out after offering responses on baseball and rousing renditions of the *Star-Spangled Banner*. Quinn and Bailey are shocked when Bob is summarily executed in front of them. Neither are swayed when the resistance guides insist he was a German infiltrator. Although it seems most viewers also don't understand why Bob was singled out as a traitor, it appears that Bob dated his written responses in the European format of day-before-month while the others must have employed the American month-before-day standard. This scene mirrors another from Quentin Tarantino's *Inglorious Basterds* (2009) involving the exposure of an infiltrator, where an undercover British commando orders beers with an English hand gesture that gives himself away to the German authorities.

As the Americans continue their journey, female members of the resistance become objects of both affection and authority, which Quinn struggles to accept. The resistance, in most European countries, was another avenue for women to surmount traditional gender roles, and the series showcases this as well.[6]

Back at Thorpe Abbotts, the bomb group is gearing up for the next big mission to Bremen. Cleven will lead the high squadron, but Egan will be in London on a pass. Cleven's plane has maintenance issues, but Sergeant Ken Lemmons (Rafferty Law), a regular in all the episodes since the group arrived in England, comes through for him.

Throughout the series, there have been the almost obligatory kudos for the maintenance troops, but not to the extent of this scene. Cleven's plane, *Our Baby*, has an issue with the number two engine and will have to abort the mission if it cannot be fixed. Lemmons assures Cleven that he can repair the problem on the runway. Riding on the left landing gear while the plane taxis, he completes the repair just as the B-17 lines up on the

5. See Donald L. Miller, *Masters of the Air: America's Bomber Boys Who Fought the Air War against Nazi Germany* (New York: Simon and Schuster, 2007), 216–20.

6. See *In the Shadows of War: An American Pilot's Odyssey through Occupied France and the Camps of Germany* (New York: Henry Holt, 2002).

runway for takeoff. Lemmons then rolls off the gear and under the wing and horizontal stabilizer to a waiting jeep, yelling "you're good to go!" to Cleven. His commitment to accomplishing the mission shines through.

The episode ends with a focus on Lemmons and his crew as the planes return from Bremen. The crew chief is disappointed to discover that *Our Baby* is not coming back, along with eight other Flying Fortresses of the group. Lemmons kicks a toolbox out of frustration, and the pain from both the loss and action is etched on his face. Only 16 of 24 crewmen return, with Cleven, Major Harry Crosby (Anthony Boyle), and Nash among the missing.

The storyline shifts to Rosenthal, who has completed his first mission and heads into debrief. Obviously stunned by the carnage he has witnessed, he is in a state of shock. He grabs a mission whiskey, but lets it go as he realizes that someone has to tell Helen that Nash is not coming home. Simultaneously, other aircrew realize that Egan must be notified as well that his best friend is also presumed dead.

Strolling down a street in London, Egan confronts the scene of a bombed-out house and mother screaming for her dead child. Once more, he witnesses firsthand the business end of strategic bombing, but he moves on, seeking news regarding the Bremen raid. At the newsstand, the headline screams Bremen has been destroyed and 30 bombers did not return. He rushes to the iconic red phone booth and calls the base. In a transparent baseball code, we all learn that Cleven is presumed dead. Egan steels himself and confirms he will be back for the next mission.

This episode widens our aperture on who has a stake in the success of the Mighty Eighth and all the lives these incredibly youthful Airmen are affecting. Simultaneously, episode 4 resets the cast of characters for dedicated viewers. The original core of the 100th is almost completely gone, and those who remain are barely hanging on. Attrition is even hitting the new crews so fast, we can barely remember them as well. Rosenthal appears to have a promising future. Will Egan be there to guide him to become a master of the air as well? As his best friend would state, don't count on it.

Dr. John G. Terino, Lieutenant Colonel, USAF, Retired

***Masters of the Air*, season 1, episode 5**.

Directed by Anna Boden and Ryan Fleck, written by John Orloff. Aired February 16, 2024, Apple TV+.

Episode 5 of *Masters of the Air* is the most searing installment yet. Classic movies such as *Twelve O'clock High* (1949), *Command Decision* (1949), *Memphis Belle* (1990), and *Fortress* (2012) have tried to convey the carnage of World War II's Combined Bomber Offensive over Europe, but none do so as effectively as this episode. This production excels at graphically illustrating the difficulty of aerial warfare and the terrible consequences in battles five miles in the air, on the ground below, at home station, and even back in the United States. Perhaps introducing directors Anna Boden and Ryan Fleck, the team re-

sponsible for directing the smash Marvel Cinematic Universe action hit, *Captain Marvel* (2019), is the reason the action sequences are so visceral in this episode. Although the 100th Bomb Group had been hardened in combat by October 1943, three straight days of missions to Bremen, Marienberg, and Münster have staggered its resolve.

Previous episodes had shown the devastation of combat and losses of the series' notable characters, who often seemed to come straight from central casting in Hollywood. They were energetic young pilots with brash demeanors, cocksure attitudes, and all the visual flair associated with the bomber boy stereotype: 50 mission crush hats, leather jackets, white scarves, sunglasses, and rakish good looks. Major John "Bucky" Egan (Callum Turner), Major Gale "Buck" Cleven (Austin Butler), and Lieutenant Curtis Biddick (Barry Keoghan) were the mainstays of the 100th.[1] Colonel Neil "Chick" Harding (James Murray) was the hard-bitten, aggressive leader we expected to lead this lot as well.[2] Now, all of them are gone—or soon will be—and a new leader has emerged.

Lieutenant Robert "Rosie" Rosenthal (Nate Mann) arrives with a bunch of other new faces to make up for the horrendous losses the hard-luck 100th has been dealt. His first mission, seen in episode 4, was the raid on Bremen, where the group lost seven aircraft. In Donald Miller's book, after his third mission in three days, Rosenthal leaves his bomber and asks the intelligence officer "Are they are all this tough?" before going with his men for medical care.[3] This episode vividly illustrates why he asked the question by highlighting the raid on Münster.

Egan views this mission as an opportunity to avenge Cleven's death. Up to this point, Egan has been the life of the party at Thorpe Abbotts, but the loss of his best friend has understandably altered his mood, making him pensive and solemn. Still in the business of dropping bombs, Egan exhibits a clear change in character as he is seen drinking and smoking in his "office," the flight deck of a parked B-17, before he careens away in a jeep for briefing.

The target of the raid is the medieval walled city of Münster. Instead of a factory or submarine pens, the Army Air Forces is going after a railroad marshalling yard in the center of town. Mirroring decades-old debates regarding appropriate targets for strategic bombing, the crews opine about whether they should target a site so close to houses and churches. Uncharacteristically, Egan ends the discussion by pulling rank and formality. Avenging Cleven is enough reason for him. As the crews head for their bombers, Egan literally puts on a new mantle of responsibility by shedding his omnipresent fleece coat for the standard leather jacket.

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1. Donald L. Miller, *Masters of the Air: America's Bomber Boys Who Fought the Air War against Nazi Germany* (New York: Simon and Schuster, 2007), 9; and Harry H. Crosby, *A Wing and a Prayer: The "Bloody 100th" Bomb Group of the U.S. Eighth Air Force in Action over Europe in World War II* (New York: HarperCollins, 1993), 36, 39–40, 260.
2. Crosby, 142, 147–48.
3. Miller, *Masters*, 20.

As we have accompanied the 100th Bomb Group in previous missions, we have seen extraordinary heroism, stoicism, and flagging discipline in keeping formation as well. The group has a welldeserved reputation for its hard charging ways and hotshot piloting, but as the missions move from the relative ease of French targets to the Third Reich, flying skills do not make up for poor formation and rigid discipline.[4] In spite of that reputation, even the best group formation of 18 unescorted Flying Fortresses is not a match for 200-plus Luftwaffe fighters coming at them head on.

Because of damage from the previous two days' missions and aborts, the 100th only has 13 B-17s heading to Münster. In about seven minutes, the group basically ceases to exist as the lead bomber with Egan at the helm is hit and other aircraft either explode almost instantly or are last seen plummeting in pieces to German soil below.[5] The mission was obviously nerve-wracking for the crews as there were more f-bombs dropped in this episode than in the previous four combined.

While waiting for the escorting fighters to withdraw—in this case aided by ground fog that kept one fighter group at base and a missed rendezvous that forced another on to turn home early—the German fighters had extra time to attack.[6] By targeting lead crews and going after individual groups, the Luftwaffe fighters eliminated experienced veterans, broke up unit integrity, and picked off dispersed individual bombers one by one. Employing rockets allowed the less maneuverable twin-engine fighters to stay out of gun range and hit bombers with devastating effect.

During this single week in October 1943, the Bloody Hundredth lost 21 planes and over 200 men missing or killed.[7] The only regular combat crew to return was that of Rosenthal. In the episode, his crew is shown far from home in a badly crippled ship, with two engines on the same wing out, a huge hole in one wing, and three gunners seriously wounded. As they lose altitude and limp home, Rosenthal maneuvers the B-17 to help his crew shoot down pursuing enemy fighters. The crew arrives back at Thorpe Abbotts, and it is a grim scene as the group maintainers and staff realize that only a single aircraft has returned.

More so than any previous episode, the influence of chance and fate is highlighted. Egan has bailed out and is on the run in Germany, and Captain Harry Crosby (Anthony Boyle), promoted to group navigator, misses the mission, probably saving his life as the man he replaced, his good friend Captain Joseph "Bubbles" Payne (Louis Greatorex), is killed in action. In reality, Payne and his crew were lost on the March 4, 1944, mission over Berlin months later. Nevertheless, the randomness of combat and the devastation of loss are amply demonstrated in this episode. Even the formerly good-natured and kind-hearted crew chief, Sergeant Ken Lemmons (Rafferty Law) grieves mightily and loses his

4. Geoffrey Perret, *Winged Victory: The Army Air Forces in World War II* (New York: Random House, 1993), 275.

5. Roger Freeman, *The Mighty Eighth: Units, Men, and Machines* (Garden City, NY: Doubleday, 1970), 77.

6. Perret, *Winged Victory*, 275.

7. Crosby, *Wing*, 147.

bearing around the English children who follow him all the time. Clearly, the losses and changes indicate the 100th is about to chart a new course, and Rosenthal will pilot the course Crosby charts into the future.

At this point, even the most cynical viewer has to question the efficacy of the Army Air Forces' bombing strategy. The horrendous losses incurred during day bombing and the suitability of striking targets near civilian areas have already made their way into the dialogue of the series. The devastating losses have increased dramatically as well. Hopefully, future episodes will deliver answers to help understand why daylight bombing remained an important element of Allied victory in World War II.

Dr. John G. Terino, Lieutenant Colonel, USAF, Retired

***Masters of the Air*, season 1, episode 6.**

Directed by Anna Boden and Ryan Fleck, written by John Orloff. Aired February 23, 2024, Apple TV+.

Masters of the Air episode 6, in addition to chronicling the aftermath of the brutal Münster mission of October 10, 1943, also unpacks a number of important topics surrounding the US Army Air Forces' bomber war against Germany. Some viewers may have missed any reference in the series to the disastrous October 14, 1943, "Second Schweinfurt" mission, which essentially forced a temporary halt to deep daylight raids into German airspace. While the raid's impact on the Eighth Air Force as a whole was enormous, in this one case the Bloody Hundredth got off lightly: after Münster, the 100th could only muster eight planes for the Schweinfurt raid, and all returned safely with no casualties.[1]

Though the show takes some chronological liberties and makes other concessions to good storytelling, the issues raised are fundamental to an understanding of the bomber war. This installment features three major plot lines: Major John "Bucky" Egan's (Callum Turner) odyssey from bail out to arrival at a prisoner of war (POW) camp; Major Harry Crosby's (Anthony Boyle) attendance at an Oxford symposium to address Anglo-American relations, and the arrival of Lieutenant Robert "Rosie" Rosenthal's (Nate Mann) new crew at Thorpe Abbotts and their stay at a rest home after three harrowing missions.

A powerful scene depicts dozens of footlockers of missing crew members being readied for shipment home, but the action soon shifts to Egan's efforts to evade capture and then deal with the first phases of his captivity. In reality, Egan's capture and transit to a POW camp were routine, but the show takes the opportunity to dramatize the range of hazards facing downed Airmen.

Shotgun-toting German farmers first capture Egan and pass him on to the authorities. While he and some fellow captives are being marched through the burning streets of a

1. Roger Freeman, *Mighty Eighth War Diary* (London: Jane's, 1981), 126.

bombed German town, a furious mob of civilians, encouraged by a party official, overpowers the guards and begins attacking the *Terrorflieger* ("terror flyers"). Most of the Airmen are killed; Egan manages to escape from the burial wagon taking them to an unmarked grave. Once again captured by the police, Egan finally passes to Luftwaffe control and finds himself at the transit camp and interrogation center known as Dulag Luft.

Egan's encounter with the lynch mob is based on a number of incidents that took place during the war. Nazi propaganda encouraged German civilians to take the law into their own hands. Photos of American pilots wearing leather jackets decorated with names such as "Murder Incorporated" were circulated in order to incite violence against Allied airmen. The Allied authorities investigated and punished a number of these crimes postwar.[2] Though not central to the episode, there are other issues of morality touched upon. We see dead civilians being pulled from the rubble, and an uncomprehending Egan glimpses a train hauling cattle cars filled with human beings—by late 1943 the extermination of the Jews of Europe was accelerating.

At Dulag Luft, Egan faces a skilled interrogator seeking to extract valuable information. US Army Air Forces personnel of the day received only minimal survival, resistance, evasion, and escape training; most knew—as Egan did—that "name, rank, and serial number" were the only permissible items to be divulged. Yet they were unprepared for the sophisticated grilling in store for them at Dulag Luft.

The urbane, cultured interrogator shrewdly combines the "brother airman" card, a disarming curiosity about baseball, and veiled threats of treating Egan as a spy. German interrogators could draw on thick files of information about every Army Air Forces unit, culled from press clippings, previous interrogations, and especially letters, diaries, photos, and even theater ticket stubs brought along on missions by careless Americans. Astonished POWs, confronted by all of this information, were easily convinced that the Germans already knew everything. So what was the harm in filling out a few "Red Cross" forms—which their interrogators claimed would serve to notify their families at home? English-speaking Germans were sometimes placed in the cells with newcaptives, masquerading as fellow Americans. Eventually, the 100th's parent Third Air Division produced educational materials warning Airmen to "Empty Your Pockets!," "Beware of Fake Forms," and "If You Didn't Know Him Before, Don't Trust Him Now!"[3] The "spy" ploy turns out to be a bluff, and the uncooperative Egan is sent to Stalag Luft III—the future site of the famed prison break, the "Great Escape"—where he is reunited with some friends.

The second subplot involves the series' narrator, navigator Crosby. Still grieving and guilt-ridden over the loss of his friend Captain Joseph "Bubbles" Payne (Louis Greatorex), Crosby is selected to represent the Army Air Forces at a symposium hosted by Balliol College, Oxford University. At the week-long event, British and American per-

2. See Kevin T. Hall, *Terror Flyers: The Lynching of American Airmen in Nazi Germany* (Bloomington: Indiana University Press, 2021).

3. Third Bombardment Division History, February 1945, US Air Force (USAF) Historical Research Agency, 527.02 Volume II.

sonnel attended lectures by distinguished dons and discussed the state of Anglo-American relations. Despite the gauzy memories of the "friendly invasion," the arrival of millions of American personnel in the UK did not always proceed smoothly. Incidents of disorderly conduct, poaching on private land, mistreatment of women, and other clashes of cultures were worrisome to the Allied leadership.

Writer John Orloff takes a bit of dramatic license here: Payne was indeed killed in action, but later in the war.[4] Still, this Oxford subplot, and Crosby's growing friendship with a British female junior officer attending the conference, largely track with the account in the real-life Crosby's outstanding memoir *A Wing and a Prayer*.

In that memoir, Crosby noted that when Egan and Major Gale "Buck" Cleven were shot down, the character of the 100th Bomb Group changed. He admits that his feelings about the two Airmen were complicated. He considered both to be outstanding, larger-than-life leaders, but he also saw within them an undisciplined aspect that did not always work to the benefit of the unit.[5]

The final subplot of this episode involves a new crew led by pilot Rosenthal. Three missions in three days, culminating with Münster—theirs was the only ship to return to Thorpe Abbotts that awful day—earn them a spell at the "Flak House."[6]

It's worth remembering that right about this time, General George S. Patton famously slapped two shell-shocked infantrymen who were patients in a Sicily field hospital. Victorian-era ideas that combat fatigue was a symptom of a character defect—pejoratively referred to as a "Lack of Moral Fiber"—persisted.[7] Yet the Army Air Forces was somewhat ahead of the curve in recognizing that even the bravest individuals have a breaking point. Though the service still dealt rather harshly with outright combat refusals, crews who had been through a harrowing set of missions were sent to a country house for a short period of recuperation, supervised by a flight surgeon and furnished with access to all sorts of genteel amenities. Later in the war "flak leave" became a normal part of a crew's combat tour.[8]

Rosenthal's crewmates take full advantage of the opportunity, but he himself bristles at the inactivity. He complains to the flight surgeon that he was just getting into his battle rhythm after three missions, and he compares himself to American jazz drummer/bandleader Gene Krupa, forced to stop playing in the middle of a set just as he was hitting his stride. The flight doc listens sympathetically, then notes that Krupa wasn't only playing for himself—he was setting the rhythm for the entire orchestra. This insight gives Rosenthal pause, and he joins his crew for the rest of the brief reprieve. He is last seen

4. Harry H. Crosby, *A Wing and a Prayer: The "Bloody 100th" Bomb Group of the U.S. Eighth Air Force in Action over Europe in World War II* (New York: HarperCollins, 1993), 241.

5. Crosby, 320.

6. See Ian Hawkins, *Münster: The Way it Was* (Anaheim, CA: Robinson, 1984).

7. Mark Wells, *Courage and Air Warfare: The Allied Aircrew Experience in the Second World War* (London: Frank Cass, 1995), 164–65.

8. See Wells.

back at the base, tapping out a Krupa-esque riff on the crew hatch of his B-17 before boarding. This neat scene foreshadows Rosenthal's rise to one of the greatest leaders to come out of the 100th Bomb Group.

Questions of morality, inter-Allied relations, and combat stress are front and center in this important segment of the series. The fortunes of the 100th Bomb Group—and indeed of the entire US Army Air Forces daylight bombing effort—bottomed out in mid-October 1943. But changes were in the works—leadership, strategic, operational, and tactical—that would radically transform the narrative. And it would be a transformation and a learning curve that the 100th would do its costly part to bring about.

Richard R. Muller, PhD

***Masters of the Air*, season 1, episode 7**.

Directed by Dee Rees, written by John Orloff. Aired March 1, 2024, Apple TV+.

Episode 7 begins the final third of the story of the 100th Bombardment Group's war, picking up after a significant chronological leap, from mid-October 1943 to March 1944. Many changes are underway both within the group and the wider war. Two narrative threads dominate this episode: the shifts in aerial strategy and tactics that would ultimately bring the Allies air mastery over Occupied Europe, and the story of Majors John "Bucky" Egan (Callum Turner) and Gale "Buck" Cleven (Austin Butler) from behind the barbed wire of Stalag Luft III.

Perceptions of the Allied prisoner of war (POW) experience are commonly shaped by Hollywood portrayals, ranging from the black comedy *Stalag 17* (1953) to the star-studded, embellished classic *The Great Escape* (1963). This series opts for a more realistic, gritty portrayal. Although the Luftwaffe ran its camps broadly in line with the Geneva Convention, there is no trace of a *Hogan's Heroes*' (1965–71) sensibility here. Malnourished prisoners catch an unfortunate cat to augment their meager rations, and we see a POW shot and wounded by guards for a minor infraction. The captured Airmen endure stultifying boredom, punctuated only by infrequent mail calls, endless card games, and occasional bits of war news gleaned from an illicit crystal radio set that Cleven manufactures from scrounged components. The POWs learn of the stalemate in the Italian theater as well as major Soviet victories on the Eastern Front—a nod to the Red Army's contribution to victory in Europe.

Egan and Cleven naturally discuss the possibility of escape, but the prospects seem dim. The camp, located deep inside Germany near Sagan in Silesia (now Poland), is far from potential resistance contacts. They are bystanders to the "Great Escape," the March 24, 1944, mass tunnel breakout of 76 Royal Air Force prisoners. The camp's new acting commandant tells the senior US officers that 50 escapees were executed. He hints darkly that control of Allied POWs might soon pass from the military to the Gestapo and asks the lead POW to identify the Jewish officers in the camp. He replies that there are only Americans present. Ultimately, Egan and Cleven resign themselves to sitting out the war.

In reality, despite fears of reprisals, little happened to the POWs remaining at the camp. Appalled by the killings, the Luftwaffe staff provided materials for the construction of a memorial.[1] Many accounts of the Great Escape use the term "executed" to describe the fate of the fifty, implying some sort of due process was involved; however, these men were murdered on orders from the highest level. Though the decisionmakers in question were beyond mortal judgment after 1945, the British painstakingly investigated and arrested the actual Gestapo killers. Most, after a fair trial, were executed.

Back at Thorpe Abbotts, the 100th endures the crescendo and eventual turning point of the daylight bomber offensive. As appropriate, most higher-level strategy debates and decisions are not dramatized as little of this percolated down to the crews flying the missions. After the crisis of autumn 1943, General Henry "Hap" Arnold, the Army Air Forces chief, cleaned house at the Eighth Air Force, sending its commander Major General Ira Eaker to the Mediterranean and replacing him with Major General James Doolittle, hero of the 1942 Tokyo raid. Lieutenant General Carl Spaatz took over a new headquarters, US Strategic Air Forces in Europe, with oversight of both the Eighth and Fifteenth Air Forces, the latter operating out of newly captured Italian bases. Arnold, in a New Year's 1944 message to all commands, insisted that gaining air superiority was the priority: "Destroy the German Air Force wherever you find it—in the air, on the ground, and in the factories."[2] A dramatic series of February 1944 raids on German aircraft factories, dubbed "Big Week"—not portrayed in the series—began the progressive eradication of the German fighter force.[3]

The effect of these sweeping changes is slow to reach Thorpe Abbotts. The group was mauled in the first major Army Air Forces attack on Berlin on March 6, 1944. The losses—69 bombers, 15 from the 100th—were the highest of the entire war.[4] The portrayal of the damaged planes' return contains some of the series' most powerful images. A crew hatch is flung open and dozens of empty .50-caliber brass casings spill out. A quick shot of a shattered, bloodstained ball turret evokes Randall Jarrell's short poem "The Death of the Ball Turret Gunner." Medics swarm over the shredded bombers, extricating and treating crewmen with all manner of horrible injuries. Some years ago, I interviewed a former Eighth Air Force medic, and he freely admitted that he still had nightmares about things he had seen 75 years earlier.

Yet amid the carnage of "Black Monday," and another brutal raid on the Reich capital two days later, some rays of hope emerge. Two missing crewmen return to Thorpe Abbotts after months spent evading capture with the help of the resistance. In line with US policy they are taken off flying status; it was too risky to permit personnel who had contact with the resistance network to return to the air. Captain Robert "Rosie" Rosenthal's

1. Paul Brickhill, *The Great Escape* (New York: W. W. Norton, 1950), 191.

2. Wesley Frank Craven and James Lea Cate, *The Army Air Forces in World War II: Volume III, Europe: Argument to V-E Day* (Chicago: University of Chicago Press, 1951), 8.

3. Donald Caldwell and Richard Muller, *The Luftwaffe over Germany: Defense of the Reich* (London: Greenhill, 2007), 144–89.

4. Jeffrey Ethell and Alfred Price, *Target Berlin: Mission 250—6 March 1944* (London: Jane's, 1981), 142.

(Nate Mann) crew hits the milestone of 25 missions and completes their tour, but their celebration is tempered by the announcement that an operational tour is now 30 missions. This "moving of the goal posts" seems capricious and heartless to the crews—but the rationale was based on a hard look at the actuarial tables. Experienced crews were a valuable commodity; with the Eighth Air Force expanding dramatically as 1944 began, Doolittle realized that he needed to hang onto his seasoned veterans. And, though it was hard to discern, Airmen's chances of survival were improving as spring 1944 wore on.

The episode also depicts the arrival of the North American P-51 Mustang escort fighter, which combined superior performance and long range. With drop tanks they could accompany the bombers to Berlin and back. Acting Group Commander Lieutenant Colonel John Bennett (Corin Silva) tells Rosenthal that, from here on in, the bombers will essentially function as "bait" to bring the German fighters into the sky so the escorts can destroy them. And indeed, the Luftwaffe day fighter force lost its entire frontline strength—and irreplaceable pilots—during spring 1944.

In the series, the arrival of the game-changing Mustangs is almost a deus ex machina. The reality is more complex—and more interesting. *Masters of the Air* focuses on the bomber experience, but it is worth emphasizing that VIII Fighter Command went through its own painful learning curve. Debates about close escort versus fighter sweeps, development of "relay" procedures to ensure coverage of bomber formations for as long as possible, and technical innovations such as auxiliary fuel tanks, were ongoing.[5] The Mustang itself was a fortuitous combination of an American airframe and a British Merlin engine. The command even published a 1940s version of a "wiki" that made the rounds: *Skywash*—a collection of combat report extracts with commentary and "lessons learned" from combat leaders.[6]

Though the episode implies that an early 1944 order from Doolittle caused the switch in focus from protecting bombers to destroying enemy fighters, the command had for months been moving toward such an air superiority strategy. A November 1943 general order stressed, "We have two scores we are aiming at; first the number of bombers we bring back safely, and second the number of German fighters we destroy."[7] Much of the heavy lifting of the early 1944 air superiority battles was borne by the P-47 Thunderbolt fighters, although the incomparable Mustang garners most of the good press.

The episode concludes with Rosenthal telling soon-to-be Group Commander Bennett that he is volunteering for a second tour. Rosenthal would ultimately command two of the 100th Bomb Group squadrons and stand in the front rank of the combat leaders who turned things around for the group. As group navigator Harry Crosby sums up in his

5. VIII Fighter Command, "Tactics and Techniques of Long Range Fighter Escort in VIII Fighter Command," July 25, 1944, US Air Force Historical Research Agency (AFHRA) 524.522.

6. VIII Fighter Command, *Skywash*, no. 1, May 1943, AFHRA 524.549A.

7. VIII Fighter Command, *Skywash*, no. 5, November 1943, AFHRA 524.549A.

memoir: "Bucky Egan and Buck Cleven gave the 100th its personality. Bob Rosenthal helped us want to win the war . . . [everybody] wanted to be like Rosie."[8]

Richard R. Muller, PhD

8. Harry H. Crosby, *A Wing and a Prayer: The "Bloody 100th" Bomb Group of the U.S. Eighth Air Force in Action over Europe in World War II* (New York: HarperCollins, 1993), 320.

***Masters of the Air*, season 1, episode 8.**

Directed by Dee Rees, written by John Orloff. Aired March 8, 2024, Apple TV+.

Instead of bomber crew members from the 100th Bomb Group within the Eighth Air Force, in episode 8 we are introduced to fighter pilots from the Tuskegee Airmen of the 99th Fighter Squadron in the Fifteenth Air Force of the Mediterranean Theater of Operations. While one might question the initial incongruency of a completely different organization in a different theater of the war, screenwriter John Orloff has held true to the compelling story of the camaraderie so prevalent in warfare by weaving in the Tuskegee Airmen's story into the overarching narrative of the 100th. While other movies such as HBO's *Tuskegee Airmen* (1995) and George Lucas' *Red Tails* (2012) focus on the Tuskegee Airmen as a collective, episode 8 offers insight into actual individuals.

The opening scene shows a flight of P-40L Warhawks on a true dusk bombing mission on June 1, 1944, to strike an ammunition dump in Italy.[1] The narration references the original World War I-era nomenclature of pursuit squadrons, which changed to fighter squadrons in 1942.[2] Notably, all four P-40s are sporting the distinctive shark mouth nose art made famous by China's Flying Tigers. While the Tuskegee Airmen were not known to paint the grins on their P-40s, the scene shows just how synonymous they had become with the P-40. The scene introduces the Tuskegee Airmen and subtly shows that at that point in the war, they were relegated mostly to a ground attack role flying obsolete aircraft.

We next see Major Harry Crosby (Anthony Boyle) in the frenzied preparation for D-Day. D-Day often evokes images of paratroopers jumping out of C-47s in the middle of the night or men storming the beaches from Higgins Boats, but rarely does it call to mind the contributions of airpower in the invasion. In addition to the targeting of railroads, bridges, and other lines of communication in the lead-up to D-Day, the previous episode showed the focus on the destruction of the Luftwaffe to ensure air superiority for the invasion. As Crosby references, instead of a single mission per day for the 100th, the invasion required multiple sorties per day. With the proximity of the Normandy region to the

1. 99th Fighter Squadron Sortie Reports, June 1943–May 1945, 2 of 4, 156, https://blackfreedom.proquest.com/.

2. Daniel L. Haulman, historian, e-mail to the author, March 13, 2024.

bomber bases in East Anglia, bombers were able to conduct quick-turn missions to strike, return, re-arm, refuel, and go back out. Not only did this maintain pressure on the German army in preventing its ability to counter the invasion, but it also provided a visual umbrella of non-stop American and Allied aircraft over the landing force, proving the Allies' attainment of air supremacy. As the supreme commander of Allied forces, General Dwight D. Eisenhower, stated in late June while surveying the Normandy beachhead, "If I didn't have air supremacy, I wouldn't be here."[3]

Crosby demonstrates the oft-overlooked fact that each of those missions had to be planned down to the minute detail—not only to secure headings, distances, and altitudes, but also to ensure deconfliction in time and space for the myriad of other aircraft flying in support of the invasion. The burden falls on Crosby as group navigator to plan all of the missions. With no time to rest, he stays awake for nearly three days of non-stop preparation until passing out from sheer exhaustion.

Episode 8 also continues to tease out the story of Sandra Westgate (Bel Powley)—the real-life Landra Wingate. Crosby could never confirm Wingate's actual role, but he long suspected she was an operative of the Special Operations Executive—the UK's counterpart to the American Office of Strategic Services, the modern CIA's precursor. Although Westgate's brief appearances do little to advance the overall narrative, they do expose how women served in the highly dangerous role of covert intelligence collection in Nazi-occupied territories during the war.

In the subsequent mission brief for D-Day we see two leadership transitions. The overt transition is in the change of command from Lieutenant Colonel John Bennett's (Corin Silva) temporary leadership of the 100th, to the permanent command of the beloved Colonel Tom Jeffrey (Christopher Lakewood)—known to 100th veterans as "Colonel Jeff"—who served as their longest-tenured commander.[4] Major Robert "Rosie" Rosenthal's (Nate Mann) also transitions from an advice-seeking neophyte pilot in episode 4, to the veteran leader and squadron commander doling out advice in episode 8, after volunteering for a second tour. Such was often the case in combat, with lieutenants rapidly rising to field-grade ranks and command positions, often due to the combat attrition of leaders.

Although we don't see any actual bombing on the D-Day missions, Rosenthal does mention the pace and scale of operations, flying multiple sorties on D-Day, and the near-mythical sight of the thousands of ships and boats in the invasion fleet, which many aviators described as a near-religious event. The fact that Crosby slept through all of it is also true to the fact that sometimes we miss the big show—either by being out of the theater of conflict, off the flying schedule, or simply asleep.

Back in Foggia, Italy, the 99th is united under the 332d Fighter Group and the legendary leadership of Colonel Benjamin O. Davis, Jr. (Jerry Mackinnon). The bar scene subtly ac-

3. Silvano Wueschner, "Key to Success: Allied Airpower at Normandy," Maxwell AFB (website), May 29, 2019, https://www.maxwell.af.mil/.

4. "Col Thomas S. Jeffrey, Jr.," 100th Bomb Group Foundation, accessed March 13, 2024, https://100thbg.com/.

knowledges the debunking of the myth that the Tuskegee Airmen never lost a bomber to enemy fighters under their escort.[5] The Airmen's combat record is one of distinction and honor that doesn't need any embellishment, yet one that had to actively counter a false narrative that grew in relatively modern years.

The following mission accurately depicts a strike on August 12, 1944, by the 332d against radar sites at Toulon in preparation for Operation Dragoon, the Allied invasion of southern France, just a few days later. Now flying P-51s, the 332d is able to conduct long-range attacks and escort bombers into Germany. Although shown flying P-51Ds with high velocity aircraft rockets (HVARs), the 332d was in actuality flying P-51B/Cs with no rockets on that mission, notable because the B/C-models had only four .50-caliber guns compared to the D-model's six, reducing available firepower by a third.[6] Without high-explosive armament like HVARs or bombs, targeting radar installations with just four machine guns was a highly inefficient task. The scene does, however, highlight the challenges of maximum range operations necessitating external fuel tanks along with the performance impact due to the drag of the external tanks and having to occasionally use aircraft movement to shake loose a "hung" tank.

In the process, Lieutenants Richard Macon (Josiah Cross), Robert Daniels (Ncuti Gatwa), and Alexander Jefferson (Brandon Cook) are shot down, with Macon sustaining a broken shoulder and neck. As in previous episodes, the German interrogators at Stalag Luft use the more relaxed, friendly interrogation method they favored over the harsh torture experienced by Airmen in other theaters from the Japanese. In his memoir, *Red Tail Captured, Red Tail Free*, Jefferson recalls not only his interrogator's love of jazz and Lucky Strike cigarettes, but also his own shock at the amount of information his captors had in his dossier, to include the maintenance inspection report completed on his very aircraft just the day prior to his fateful mission.[7]

The interrogation also reveals the common sentiment of the Tuskegee Airmen—who fought for a country that treated them as second-class citizens— that America, though not perfect, was worth fighting for. These Airmen were in fact fighting two wars: the war against Nazi tyranny and the war against segregation and racism at home. Many African-American veterans from World War II went on to be civil rights advocates and leaders, inspired by their combat service to fight at home for a better America.

Despite segregation at home and a segregated military, Black Airmen were forced into integration in the shared experience as prisoners of war (POW). White and Black Airmen relied on each other to survive. As the episode reveals, when Macon, Daniels, and Jefferson were shot down, many POWs had already been in prison for up to a year or

5. Daniel L. Haulman, *Tuskegee Airmen Myths and Realities* (Maxwell AFB, AL: US Air Force Historical Research Agency, 2014), 7.

6. 99th Fighter Squadron Sortie Reports, June 1943–May 1945, 3 of 4, 110, https://blackfreedom.proquest.com/.

7. Alexander Jefferson, *Red Tail Captured, Red Tail Free* (New York: Fordham University Press, 2005), 55–60.

more and had no idea about the Tuskegee Airmen. Seeing the men at the POW camp was a surprise for most.

Only 12 Tuskegee Airmen were held in Stalag Luft III, but when a downed bomber pilot later shows up and excitedly claims that "if the Red Tails had been escorting us we wouldn't have gotten shot down," declaring "how many times the Red Tails saved [them]," word about their reputation in combat quickly spreads through the camp.[8] In his memoir, Jefferson notes with irony that a white prisoner from the South—Major Gale "Buck" Cleven (Austin Butler) in the movie, but a different prisoner in reality—chose him to bunk in his room because he knew Jefferson wasn't a spy. Jefferson says he likely would have "caught hell" from a white Southerner back home. But in the POW camp, ironically, he was trusted because he was Black.[9]

Lieutenant Colonel Matthew Ziemann, USAF

8. Jefferson, 76.
9. Jefferson, 65.

***Masters of the Air*, season 1, episode 9**.
Directed by Tim Van Patten, written by John Orloff. Aired March 15, 2024, Apple TV+.

Episode 9 brings the war in Europe—and thus the story arcs—to an end. It begins with Major Robert "Rosie" Rosenthal (Nate Mann) leading the 100th Bomb Group and the entire 3rd Air Division on a strike against Berlin on February 3, 1945, complete with P-51 escorts.[1] This scene does well to show the scale of air operations by that point in the war with the "thousand plane raids." The February 3rd mission included over two thousand aircraft—1,437 heavy bombers and 948 fighters—to strike right at the heart of the Third Reich.[2] As Navigator Major Harry Crosby (Anthony Boyle) narrates, the men of the Army Air Forces have gained air superiority and are truly "masters of the air."

Yet air superiority does not mean impunity, as Rosenthal's crew is shot down. Mann does a terrific job showing not only Rosenthal's command of his crew and his aircraft on the bomb run, but also the difficulty in getting out of an aircraft that is spinning out of control. Many crew members were unable to bail out of bombers due to being pinned against the aircraft by centrifugal force, spinning to their deaths. Upon landing, Rosenthal breaks the same arm that he broke in his first crash—a forced landing in France—and convinces advancing Russian soldiers that he's an American. As the book on which the series is based reveals—in a moment where reality seems even more bizarre than

1. Donald L. Miller, *Masters of the Air: America's Bomber Boys Who Fought the Air War against Nazi Germany* (New York: Simon & Schuster Paperbacks, 2024), 423.
2. Robert Dorr, "The Bombing of Berlin by Doolittle's Eighth Air Force," *WWII Quarterly* 5, no. 3 (2014), https://warfarehistorynetwork.com/.

Hollywood—Rosenthal was actually greeted with a bear hug from the Russian soldier who only moments prior pointed a rifle at him.[3]

During Rosenthal's time with his Russian hosts he visits what historians believe to have been the Zabikowo camp near Poznan, Poland, where prisoners—mostly Jews—were hung, shot, and burned. While some rumblings of "death camps" were shared among Allied personnel, it wasn't until the discovery of the multitude of concentration camps that the true horror and scale of the wholesale industrial extermination of Jews and other persecuted groups became known to the world.[4]

Episode 9 also exposes the audience to the brutality of the "Blizzard March," when prisoner of war (POW) camps were hastily evacuated in late January 1945 as the Allies closed in on the Reich and the POWs were moved deeper into the German heartland, potentially to be used as hostages. Utter chaos ensues as 10,000 POWs from Stalag Luft III prepare for a trip of unknown duration and destination in blizzard conditions with just 30 minutes' notice. Within that half hour, some POWs chose to consume as much food as possible, paying dearly for it later as their shrunken stomachs forced them to vomit. Others made hasty decisions as to what they could carry on makeshift sleds.[5]

The line of prisoners from Stalag Luft III extended 30 miles and spanned days and nights of marching. POWs were packed into cattle cars with human and animal feces on the floor, with many suffering from dysentery and hypothermia. There were a few fatalities from an air attack by an unwitting P-47.[6] Shared misery led to shared humanity, accurately depicted as one POW is shown helping a German guard who struggles to keep up on the march.

The Muskau brickworks factory provides a brief respite for warmth before the march continues on to Nuremburg's Stalag XIIIB and eventually to the overcrowded Stalag VIIA in Moosburg, where POWs joined with thousands of other Allied prisoners from across the British empire, ballooning to a total camp population of over 100,000. In reality, for nearly three months, even the Red Cross didn't know where the prisoners were.[7] Of note, while Lieutenant Colonel Albert Patton "Bub" Clark (Sam Hazeldine) is shown as the senior American officer from Stalag III, in actuality it was Colonel Darr Alkire—the original stateside commander of the 100th, ironically—who served in this role. Alkire later took command of a B-24 group.[8]

Although little backstory is given, we meet George Neithammer (Josh Dylan), a college friend of Major Gale "Buck" Cleven (Austin Butler) from Wyoming. Neither knew that the other had joined the Air Corps until they saw each other as POWs and later

3. Miller, *Masters of the Air*, 424.
4. "Zabikowo Camp," Holocaust Historical Society, February 5, 2022, https://www.holocausthistoricalsociety.org.uk/.
5. Miller, *Masters of the Air*, 492–505.
6. Miller.
7. Miller.
8. Miller.

made their escape together. While Major John "Bucky" Egan (Callum Turner) is shown fighting with a guard while Cleven and two others escape, the true story is an even more compelling example of duty. When Cleven told Egan about his plans to escape, Egan told him that as Alkire's provost to maintain order among the POWs, he was duty bound to stay with the prisoners, sacrificing his chance for freedom for the greater good.[9]

Fortunately for viewers, the episode depicts the liberation of Stalag VIIA by General George S. Patton's Third Army. With a little dramatic license, red-tail P-51s are shown visible from the camp, strafing the nearby Moosburg train station. Skirmishes between German guard towers and American forces preceded the camp's liberation. Seeing the American flag raised over the town of Moosburg, Egan remarks on the tears and salutes across camp before he eventually replaces the Nazi flag over the camp as well.

A different form of airpower is shown with the Operation Chowhound/Manna airdrops of food to the people of the Netherlands. True to screen, bombers and crews accustomed to dropping tons of death and destruction took joy in bringing life and sustenance instead, witnessing the demonstration of genuine gratitude from the Dutch, who spelled out "MANY THANKS, YANKS" in a tulip field.[10] Such missions were widely popular among the Airmen, who leapt at the chance to do something positive after enduring the horrors of war. One history records the reaction of one such crew member:

> Children ran out of school waving excitedly. One old man stopped at a crossroads and shook his umbrella. The roads were crowded with hundreds of people waving. Nobody spoke in the aircraft. My vision was a little misty. Perhaps it was the rain on the Perspex.[11]

The episode also captures perhaps one of the more enduring legacies of the Eighth Air Force: the profound bond between American Airmen and their English hosts—often referred to as the "Friendly Invasion." Children like Sammy Hurry (Alfie Tempest) did in fact spend most of their free time on base with the ground crews, and townspeople came out in their Sunday best to see the crews fly off one last time for home.[12] The strong connection between the Airmen and the countryfolk is evident in the local museums established and maintained after the war to honor those who served. The historical accuracy of the *Masters of the Air* set was largely due to the photos and memories preserved by the local Brits who maintain the museum at Thorpe Abbotts, the actual home of the 100th.

The episode also shows the emotional toll the war had on the Airmen. In contemplating the end of the war, Crosby and Rosenthal try to reconcile what they, as individuals, did in war. While just war theory and the law of armed conflict clearly state that the use

9. Kirk Saduski, historian, interview by author, March 8, 2024.

10. Miller, *Masters of the Air*, 490.

11. Edward Jablonski, *Air War,* Volume IV (New York: Doubleday & Company, 1979), 122.

12. Chuck Dunning, "Keepers of the Castles of Little America," *British Heritage Travel*, September 23, 1997, https://britishheritage.com/.

of force in World War II was justified, many still wrestled with its moral and ethical challenges. Rosenthal himself, whom many believed volunteered for a second tour because he was Jewish or had family members imprisoned in Germany, notes, "I didn't do it because I was a Jew, I did it because I was human, and I can't stand bullies."[13]

The episode's coda shares what happened to a number of the main characters after the war, demonstrating the diversity of experiences in post-war life common to World War II veterans. Some stayed in the service, others became lawyers or teachers, or obtained advanced degrees—in other words, they moved on with life. Many did not talk about their service—especially to their families—for years, if ever.[14]

Masters of the Air succeeds in showing ordinary people doing extraordinary things during the horror of warfare. No other screen portrayal to date has succeeded in showing the full scale of mass daylight bombing raids. For general viewers, the series highlights the courage and sacrifices of the Airmen of the Eighth Air Force and those in the English countryside who kept them flying. It also reveals the brutality of warfare in the subfreezing cold blue. For today's Airmen, *Masters of the Air* shows our origin story—the doctrine and strategy developed here at Maxwell Field in the 1930s and the culture of Air Corps Airmen that lives on today.

Lieutenant Colonel Matthew Ziemann, USAF

13. Donald Miller, interview by author, February 16, 2024.
14. Saduski.

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