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Air & Space Operations Review

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Toxic Senior Military Leaders in the Cockpit

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Air & Space Operations Review

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Dear Reader,

A quick Google search for books on the subject of change yields myriad tomes across many fields and areas of professional, personal, and academic interest. Clearly, we are interested in the topic, even if it seems we often feel more comfortable avoiding change itself.

From the minutiae around us every day, to the broader social, environmental, and professional orbits we inhabit, to the very fact that we exist on a planet hurtling rather rapidly through space—at about 67,000 miles per hour in fact—it is clear that any sense of stasis an illusion. My vocational title is the same today as it was yesterday, but the work I did yesterday is substantively different than the work I am doing today. Our routes of daily life—the streets, roads, sidewalks, and trails we travel—may not vary, but these paths we traverse differ materially from one day to the next, even if only at the molecular level. We know now that even the universal laws of physics are not necessarily immutable.

Some researchers on the notion of self have even proposed that due to the significant growth and aging of our bodies over our lifetimes, our current physical self is an entirely different individual than the younger versions of ourselves. Truly, far from being something out of the ordinary, change is a constant. As many have said before, the question is not how do we avoid change, but how can we manage it in order to improve our lives, our work, and our society?

Our summer issue of *Air & Space Operations Review* takes up this popular theme of change. Our first forum, *The Changing Battlespace,* leads with an article by Kaitlyn Benton and Timothy Leslie. Their study on increased density altitude projections out to 2099, based on rising temperatures worldwide, finds that the US military will face notable degradation in current strategic lift capabilities. In the second article in the forum, Cole Mooty, Robert Bettinger, and Mark Reith propose adapting the current notion of exclusion zones used for single-domain control to a comprehensive approach—domain exclusion zones—to counter adversaries in all domains.

The third article in the forum considers another aspect of conflict in the newest warfighting domain—space. Jennifer Cannon analyzes historical attacks against terrestrial dual-use targets, revealing geopolitical, operational, and international law themes that can be applied to planning for and responding to attacks against dual-use satellites in current and future conflicts. Alexander Farrow and Victor Lopez conclude the forum, narrowing the focus to the squadron level. They argue squadron commanders must encourage data innovation and artificial intelligence ideation in their units by carefully constructing a data strategy, managing infrastructure, cultivating technical talent, redesigning the organization, and fostering a culture of innovation.

Our second forum, *Organizational Change,* features an article by Daniel Watson, Christopher Paige, and Douglas Robb, who explain how recent congressionally directed changes that centralize authority, direction, and control of military treatment facilities create a dual authority structure at these facilities. This inefficient construct creates conflict between capacity and capability, resulting in tension and risk to operational missions.

The forum concludes with an article by Joshua Bringhurst and Emma Palombi on toxic senior military pilots and the threats these individuals can pose to missions and ultimately to people's lives. They propose changes to training to help identify and respond to these rogue aviators to improve operations and safety.

Thank you for taking the time to read our summer issue. As you venture forward into the second half of this year, we hope the change you experience in 2023 edifies and empowers you!

~The Editor

Barriers to Force Projection

Climate Change and Aerial Forward Operability

Kaitlyn M. Benton
Timothy F. Leslie

While US national security and military strategy documents acknowledge climate change will have increasing effects on US military operations alone and with Allies and partners, the specific implications for platforms remain understudied. An analysis of the projected effects of rising temperatures worldwide to 2099 on density altitude and its specific impacts for the C-17 Globemaster, provides insights into developing courses of action to mitigate the certain reduction of logistics capabilities.

In a time plagued by the reemergence of great power competition, the importance of a nation's military cannot be underestimated. The argument for persistent forward stationing of US military forces is based on two key principles of military strategy: assurance and deterrence. As part of its global posture and campaigning effort and in addition to deterring Russia and China in the Indo-Pacific region and Europe, the *2022 National Defense Strategy* states the Department of Defense "will leverage security cooperation and capacity building with partners, backed by a monitor-and-respond approach that takes advantage of the deterrent value of the Department's ability to deploy forces globally at the time and place of [its] choosing."[1]

This research is focused on the impacts that climate warming may have on strategic-level military readiness and decision-making, particularly within the US Air Force. It is known that the aviation industry is a partial contributor to global climate change.[2] What has been somewhat overlooked as a field of study is the reverse dynamic: the impact of climate change on aviation.[3] Considering the forecasted increase in regional mean

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1. Lloyd F. Austin, *2022 National Defense Strategy of the United States of America including the 2022 Nuclear Posture Review and the 2022 Missile Defense Review* (Washington, DC: Office of the Secretary of Defense, 2022), 13, https://media.defense.gov/.

2. Milan Klöwer et al., "Quantifying Aviation's Contribution to Global Warming," *Environmental Research Letters* 16, no. 10 (November 2021), https://doi.org/.

3. Mary McRae et al., "Assessing Aircraft Performance in a Warming Climate," *Weather, Climate, and Society* 13, no. 1 (January 2021), https://doi.org/; and Tianjun Zhou et al., "Impact of 1.5°C and 2.0°C Global Warming on Aircraft Takeoff Performance in China," *Science Bulletin* 63, no. 11 (June 2018), https://doi.org/.

temperatures, what impact will climate warming have on US Air Force strategic airlift capabilities, and how will this affect geostrategic defense priorities? In other words, what theater-level geographic impacts will the Air Force and the Department of Defense experience due to the loss of airlift capacity resulting from extreme climate change?

Strategic- and theater-level implications first emerge at the tactical level of military operations. Accordingly, to reach an understanding of the strategic impacts that climate warming is bound to have on the Air Force's ability to project power globally, the impacts on tactical-level flight operations must be quantified.

As the most flexible transport aircraft in the US Air Force fleet, the Boeing C-17 Globemaster III is an effective case study for such problems likely to be faced across the service. This study converts climate-warming projection data from 2020–2099 to measures of density altitude—"pressure altitude corrected for nonstandard temperature variations"—and assesses the impacts of increasing density altitude based on a set of mathematically approximated thresholds specific to the C-17.[4] The density altitude thresholds provide metrics for quantifying regional performance degradation of the C-17 due to global warming.[5]

Pressure and Density Altitude

Pressure altitude, density altitude, and maximum takeoff weight are common metrics for assessing aircraft performance under limiting circumstances, such as high elevation, high temperature, or low-density air.[6] Both elevation and temperature have a significant impact on the maximum takeoff weight and runway length requirements for all aircraft due to their impacts on lift. Understanding the effects of elevation and temperature on aircraft performance begins with understanding pressure altitude and density altitude, two related aeronautical concepts.

Pressure altitude is defined by the Federal Aviation Administration (FAA) as "the height above a standard datum plane (SDP)," or the theoretical level where the weight of the atmosphere is 14.7 pounds per square inch, or 29.92 inches of mercury (″Hg), measured by a barometer.[7] Restated, pressure altitude refers to the indicated altitude displayed on an altimeter when it is set to standard atmospheric pressure: 29.92 ″Hg.[8]

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4. Federal Aviation Administration (FAA), *Density Altitude* (Washington, DC: US Department of Transportation [DoT], 2008), 1, https://www.faasafety.gov/.

5. Mary McRae, "A Risk-Based Approach to Planning Aircraft Acquisitions in a Warming Climate" (PhD dissertation, Villanova University, 2019).

6. Ethan Coffel and Radley Horton, "Climate Change and the Impact of Extreme Temperatures on Aviation," *Weather, Climate, and Society* 7, no. 1 (January 2015), https://doi.org/; and Christopher J. Goodman and Jennifer D. Small Griswold, "Climate Impacts on Density Altitude and Aviation Operations," *Journal of Applied Meteorology and Climatology* 57, no. 3 (March 2018), https://doi.org/.

7. FAA, *Pilot's Handbook of Aeronautical Knowledge* (Washington, DC: DoT, 2016), 4-4.

8. FAA, *Density Altitude,* 1.

Standard atmospheric conditions assume a sea-level pressure of 29.92 ″Hg, a temperature of 15 degrees Celsius, and a humidity of zero percent. Nonstandard atmospheric conditions are simply any deviation from any of these conditions. Changes in atmospheric pressure produce nonstandard conditions, necessitating a measure for altitude that takes these factors into account. On a perfectly standard day, pressure altitude is equal to true altitude, the height at which the aircraft is physically flying. Pressure altitude is a function of atmospheric pressure and elevation and is measured independently of temperature.[9]

Density altitude is pressure altitude corrected for temperature.[10] Much like pressure altitude, the density altitude refers hypothetically to the altitude above sea level where one would find the specified atmospheric density in the standard atmosphere: "As temperature and altitude increase, air density decreases. In a sense, it's the altitude at which the airplane 'feels' it's flying."[11] Decreasing near-surface air density is "the single most significant atmospheric parameter" in examining the relationship between climate-warming effects and aircraft performance, specifically maximum takeoff weight.[12]

High-density altitude affects fixed-wing aircraft in the following three critical ways: 1) it causes less lift due to the decreased force exerted on the wings by less dense air, 2) it produces diminished thrust on propeller aircraft from reduced prop efficiency, and 3) it creates reduced power because of the engine taking in less air.[13] These performance limitations produce flight circumstances which do not allow for an aircraft to accelerate as quickly on takeoff, resulting in decreased maximum takeoff weight and increased takeoff distance.[14]

Aircraft Selection

To assess the US Air Force's ability to project power globally, analysis must be done using an effective representative aircraft. The Boeing C-17 Globemaster III is an ideal selection for several reasons. The Air Force refers to the C-17 as its "most flexible cargo aircraft to enter the airlift force."[15] The Globemaster III is lauded for its rapid troop delivery and deployment, versatile mission capabilities, and overall contribution to worldwide airlift demands.[16] The C-17 supports the rapid deployment of logistics supplies, troops, and aircraft/vehicles. The Air Force recognizes the growing requirements for heavy cargo

9. FAA, *Pilot's Handbook*, 4-4.

10. FAA, 4-4.

11. Aircraft Owners and Pilots Association (AOPA), "Density Altitude," AOPA, accessed May 12, 2023, https://www.aopa.org/.

12. Diandong Ren et al., "Impacts of Climate Warming on Maximum Aviation Payloads," *Climate Dynamics* 52 (August 2018), https://doi.org/.

13. McRae et al., "Assessing Aircraft Performance."

14. McRae et al., "Assessing Aircraft Performance"; Coffel and Horton, "Climate Change"; and Zhou et al., "Impact of 1.5°C."

15. US Air Force (USAF), "C-17 Globemaster III," USAF (website), accessed July 21, 2022, https://www.af.mil/.

16. USAF.

aircraft for both wartime and humanitarian missions across the globe. Given its flexibility and wide usage, the C-17 is an appropriate aircraft to use for an assessment of DoD forward projectability.

Further indication of the value and relevance of the C-17 is evidenced by the long list of global users that the aircraft services. According to the manufacturer, while the US Air Force is the C-17's largest customer, seven additional countries and one multinational initiative also own and operate C-17s: Australia, Canada, India, Kuwait, Qatar, the United Arab Emirates, the United Kingdom, and the participating nations of the Strategic Airlift Capability (Hungary, Bulgaria, Estonia, Lithuania, the Netherlands, Norway, Poland, Romania, Slovenia, Finland, Sweden, and the United States).[17] The wide use of the C-17 by the United States and Ally and partner nations suggests results of this research may apply beyond the scope of the US Department of Defense.

Data and Methodology

The key data supporting this research is a set of forecasted temperature and relative humidity values under a "worst-case scenario" global warming model.[18] This data set is called the Coupled Model Intercomparison Project Phase 5 (CMIP5) and is a recurring data source used by other scholars in this field of research.[19] While a more recent release—CMIP6—has a more current baseline period, this newer model has been found to be overly conservative when predicting climate change, and when compared with the earlier released CMIP3 and with CMIP6, CMIP5 shows projections most consistent with climate observations.[20]

The worst-case scenario refers to the projected emissions and human efforts with emissions and associated concentrations increasing considerably. Specifically, the authors used Representative Concentration Pathway 8.5 (RCP 8.5), which models a radiative force of 8.5 watts per square meter by the end of the century. CMIP5 includes model scenarios of varying degrees of severity, but for the sake of this research inquiry, the worst-case global warming outcome is used to demonstrate the importance of mitigation against this potential threat. The forecasted temperature values are relative to CMIP5's historical baseline average temperatures from 1986 to 2005 and are used to estimate

17. Boeing, "C-17 Globemaster III," Boeing (website), accessed July 21, 2022, https://www.boeing.com/; and Strategic Airlift Capability (SAC), "Member Nations," SAC, accessed July 21, 2022, https://www.sacprogram.org/.

18. Karl E. Taylor, Ronald J. Stouffer, and Gerald A. Meehl, "An Overview of CMIP5 and the Experiment Design," *Bulletin of the American Meteorological Society* 93, no. 4 (April 2012), https://doi.org/; Zhou et al., "Impact of 1.5 °C"; and Wei Yuan et al., "Estimating the Impact of Global Warming on Aircraft Takeoff Performance in China," *Atmosphere* 12, no. 11 (November 2021), https://doi.org/.

19. Coffel, Thompson, and Horton, "Impacts of Rising Temperatures"; McRae et al., "Assessing Aircraft Performance"; and Yuan et al., "Estimating the Impact."

20. D. Carvalho et al., "How Well Have CMIP3, CMIP5 and CMIP6 Future Climate Projections Portrayed the Recently Observed Warming," *Scientific Reports* 12, no. 1 (July 2022), https://doi.org/.

global warming temperatures during two of the four available 20-year prediction periods (2020–2039 and 2080–2099). [21]

The metric used to assess aircraft performance degradation is density altitude. The raw data inputs include forecasted temperature and relative humidity values for each of the 20-year periods from 2020–2099, as well as elevation data across the study area. Global elevation data was compiled from the US Geological Survey Global 30 Arc-Second Elevation (GTOPO30) digital elevation model archive. Forecasted temperature, relative humidity, and elevation can be converted into forecasted density altitude using a series of equations.[22] The formulas used to do this conversion come from the National Oceanic and Atmospheric Administration's (NOAA) online density altitude calculator.[23]

The outcome of this methodology is two separate map visualizations of density altitude values across the geographic combatant commands, representing the forecasted density altitude for each of the prediction periods. These maps are then compared against one another to assess the geographic-based deterioration of flight conditions based on increasing density altitude.

Density Altitude Thresholds and Associated Tactical Impacts

To numerically assess the effects of increasing temperatures on C-17 capabilities, six density altitude thresholds were defined. Increased density altitude results in increased performance degradation, and at each of the six thresholds, a weight restriction is imposed to compensate for that degradation.

Table 1. Density altitude increases and weight reduction compensation for the C-17 Globemaster III

	Density Altitude	Weight Reduction	Cargo Allowance
1	≥ 710 feet	14,500 pounds (8.5 percent payload)	e.g., 1 of 2 UH-60
2	≥ 1,420 feet	29,000 pounds (17.0 percent payload)	e.g., 0 of 2 UH-60
3	≥ 2,440 feet	50,000 pounds (29.3 percent payload)	e.g., 1 of 2 M2A2
4	≥ 4,880 feet	100,000 pounds (58.5 percent payload)	e.g., 0 of 2 M2A2
5	≥ 7,180 feet	147,000 pounds (86.0 percent payload)	e.g., 1 of 2 M1A2
6	≥ 8,350 feet	170,900 pounds (100 percent payload)	No payload

21. Taylor, Stouffer, and Meehl, "Overview."

22. Tim Brice and Todd Hall, "Density Altitude [Calculator]," National Oceanic and Atmospheric Administration (NOAA), 2015, accessed July 21, 2022, https://www.weather.gov/; John M. Wallace and Peter V. Hobbs, *Atmospheric Science: An Introductory Survey* (Amsterdam, NL: Academic Press, 2006); and Mark G. Lawrence, "The Relationship between Relative Humidity and the Dewpoint Temperature in Moist Air: A Simple Conversion and Applications," *Bulletin of the American Meteorological Society* 86, no. 2 (February 2005), https://doi.org/.

23. Brice and Hall, "Density Altitude [Calculator]."

The C-17 Globemaster III has a maximum takeoff weight of 585,000 pounds, a maximum payload of 170,900 pounds, and cargo configurations which allow for (1) 102 troops/paratroops, (2) 54 ambulatory patients, 36 litter patients, and their medical attendants, or (3) 18-463L cargo pallets.[24] Additionally, a full Globemaster III payload may consist of one M1A2 Abrams tank, two M2A2 Bradley infantry fighting vehicles, up to three Stryker vehicles, or two UH-60 Black Hawk helicopters.[25] For the purpose of this study, the C-17 will be modeled as taking off with the maximum fuel allowance.

Impacts on Aircraft Performance

Density altitude is the metric by which the performance of the C-17 Globemaster III is assessed throughout the warming period from 2020–2099. As temperatures rise, density altitude increases. An aircraft at an elevated density altitude due to either increased field elevation or increased temperatures experiences atmospheric densities that mirror those at a higher altitude, despite the aircraft flying much lower. Flying conditions at higher altitudes are deteriorated compared with lower altitudes, so an aircraft flying at a high-density altitude experiences degraded performance. Therefore, each density altitude threshold defined in the previous section indicates an altitude where the performance of the C-17 is degraded in such a way that a new maximum takeoff weight must be defined.

The study area—including US Northern Command (USNORTHCOM), US Southern Command (USSOUTHCOM), US European Command (USEUCOM), US Central Command (USCENTCOM), US Indo-Pacific Command (USINDOPACOM), and US Africa Command (USAFRICOM)—was classified according to the number of months per year that a particular location within the combatant command would not be subject to the takeoff weight restriction imposed by each of the six density altitude thresholds. The level of performance degradation used in the classification ranges from none to year-round:

- None: 12 months per year that the C-17 is not subject to density altitude threshold limitations
- Minimal: 10–11 months
- Increased: 8–9 months
- Significant: 5–7 months
- Severe: 3–4 months
- Critical: 1–2 months
- Year-round: 0 months

24. SAC, "Boeing Globemaster III C-17," SAC, accessed May 12, 2023, https://www.sacprogram.org/; and USAF, "C-17 Globemaster III."

25. SAC.

The first density altitude threshold is set to 710 feet and signifies the altitude at which the performance degradation of the C-17 necessitates an 8.5 percent decrease in maximum payload. This is equivalent to approximately 14,500 pounds and has a tactical impact of reducing the C-17's cargo allowance by one UH-60 Black Hawk helicopter, despite the C-17 being able to fit two UH-60s in its cargo hold. In just the first segment of the warming period, 2020–2039, USSOUTHCOM, USAFRICOM, USCENTCOM, and USINDOPACOM each experience year-round performance degradation in over 50 percent of their areas. USSOUTHCOM and USAFRICOM are nearly 100 percent geographically degraded year-round at 86.7 percent and 96.6 percent, respectively.

This means that in a majority of locations in four out of the six geographic combatant commands, the C-17 will be under an 8.5 percent payload restriction year-round. All six commands experience some varying degree of increase in the land area that will see year-round weight limitations imposed by the first density altitude threshold, with USCENTCOM and USINDOPACOM showing the largest increase over the warming period. The portion of USCENTCOM that has weight limitations imposed year-round under the first density altitude threshold is expected to increase by 7.6 percent, and USINDOPACOM is expected to see an 8.1 percent increase. USNORTHCOM and USEUCOM also experience an increase in land classified as either critical or severe.

The second and third density altitude thresholds exhibit similar patterns to the first threshold. USSOUTHCOM, USAFRICOM, and USINDOPACOM lead the commands as the regions with the highest percentage of their land area classified as year-round weight restrictions. Again, USCENTCOM trails close behind these three commands. The second density altitude threshold is 1,420 feet, where the maximum allowable payload must be decreased by 17.0 percent (about 29,000 pounds). The tactical impact of such a weight restriction is the complete inability for the C-17 Globemaster III to transport UH-60 Black Hawks.

The third density altitude threshold at 2,440 feet is equivalent to a 50,000-pound decrease in maximum allowable payload at takeoff, which corresponds with a 29.3 percent payload decrease and tactically, the C-17 being limited to transporting only one M2A2 Bradley infantry fighting vehicle. The C-17 is equipped to transport two of these vehicles at full functionality. The third density altitude threshold represents the threshold that is both geographically and mission relevant as compared to the other thresholds. Threshold #3 not only imposes a significant payload reduction at 29.3 percent, but it also has a substantial geographic impact as shown in figure 1.

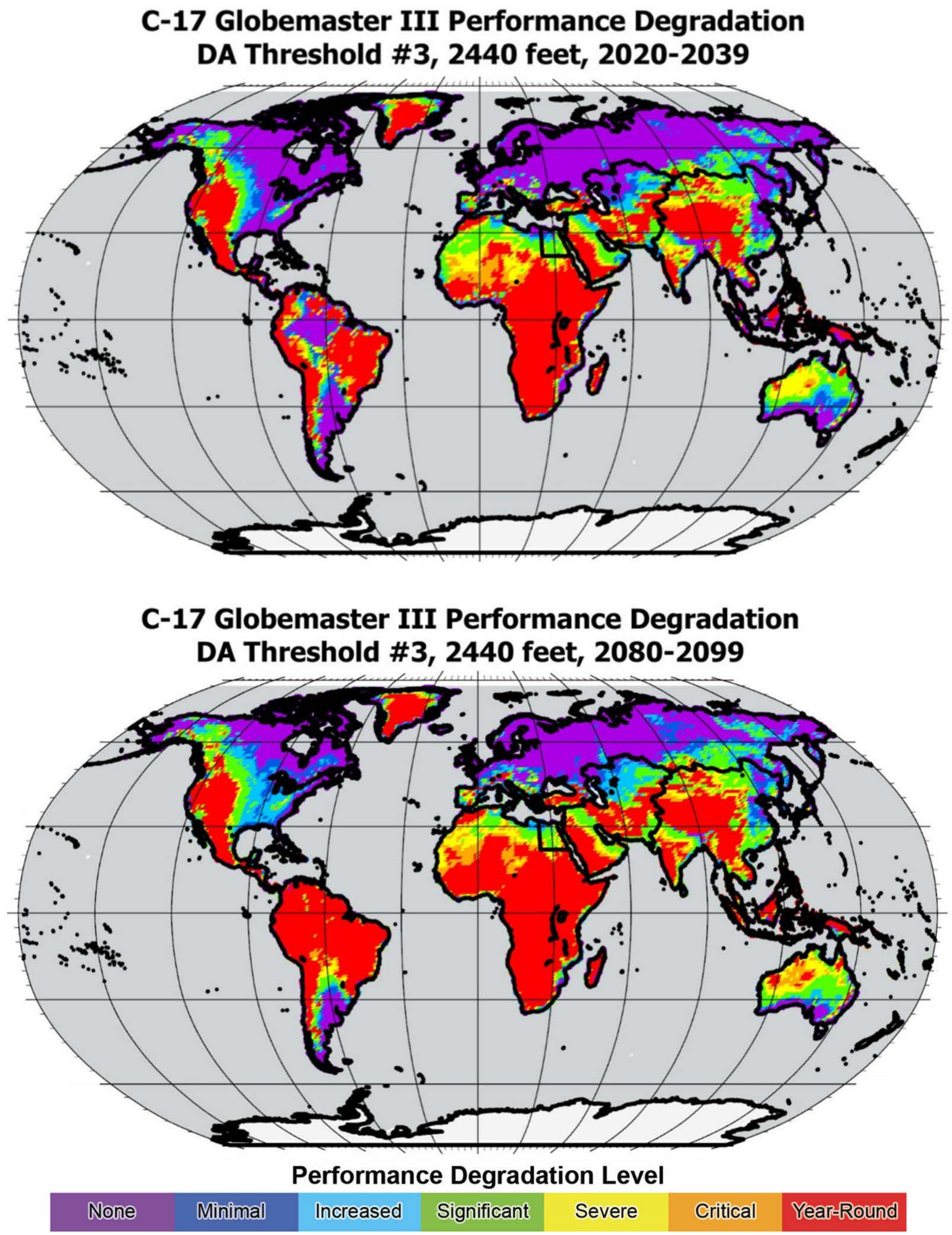

Figure 1. Performance degradation experienced by the C-17 imposed by the third density altitude threshold

Approximately 68.9 percent of USSOUTHCOM, 72.6 percent of USAFRICOM, and roughly 36 percent of both USCENTCOM and USINDOPACOM are expected to experience a year-round 29.3 percent payload reduction by the year 2099. An additional 9.4 percent of USAFRICOM, 4.5 percent of USCENTCOM, and 7.7 percent of USINDOPACOM are predicted to be classified as critical performance degradation by 2099, indicating only one to two months per year that the C-17 is not subject to the 29.3 percent payload reduction.

Between the third and fourth density altitude thresholds, the percentage of each combatant command that will experience year-round weight restrictions decreases substantially more than what is observed between the first and second thresholds, and again between the second and third thresholds. Under threshold #3, 25 percent of the land area in four out of the six combatant commands is classified as requiring year-round weight restrictions. For threshold #4, however, the maximum land-area percentage needing year-round limitations by 2099 is 17.1 percent in USAFRICOM.

All six commands will experience increases in land area classified at these extreme degradation levels. But given that the land area no longer exceeds 25 percent of the geographic region, it is much more realistic that loss of functionality at this threshold could be more easily managed and adapted to. For reference, density altitude threshold #4 corresponds with a 58.5 percent payload reduction, which has a tactical impact of the C-17 no longer being able to carry any M2A2 Bradley vehicles, despite being outfitted to carry two. This is the equivalent of a 100,000-pound decrease in takeoff weight.

As a consideration of which commands might experience the most noticeable changes through the model process, this article computes the percentage of land area for each combatant command that exceeded various thresholds. Figure 2 shows these regions where the density altitude increases by 100 percent or more between 2020 and 2099. In particular, this graphic offers interesting perspectives on USNORTHCOM and USEUCOM. The top 25 percent of the study area that experiences the most rapidly increasing density altitude corresponds with the regions that at the very least double in their value. These regions are experiencing increasing density altitude at a rate that is greater than the remaining 75 percent of the study area and should be considered a unique threat to the Department of Defense.

Even at the lowest density altitude threshold of 710 feet, USNORTHCOM only sees density altitude conditions mandating a year-round weight restriction across approximately 25 percent of its area, with a portion of that area belonging to the higher elevation Rocky Mountains. Despite USNORTHCOM not showing substantial evidence of strategic-level threat from climate warming, figure 2 highlights how USNORTHCOM is increasing in threat more rapidly than surrounding regions. The threat to C-17 performance may not exist substantially during the warming period in this study, but combatant commanders and other senior leaders should pay close attention to which portions of the map are expected to deteriorate more rapidly than others.

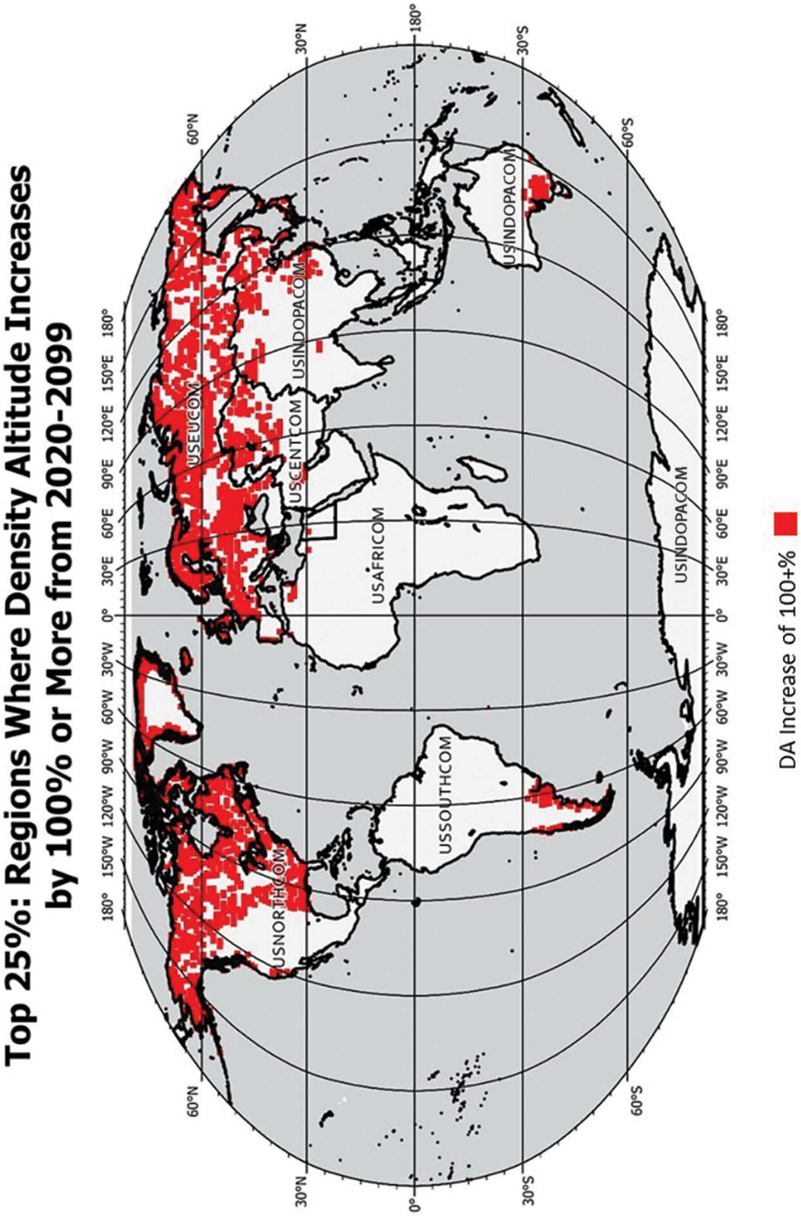

Figure 2. Top quartile of rates of density altitude increases between 2020 and 2099

Reassurance and Deterrence

Forward stationing and deployment of US military forces, whether for offensive military campaigns or peacekeeping and humanitarian purposes, is based on the principles of reassurance and deterrence. The *2022 National Defense Strategy* declares the US military responsible for assuring US Allies and partners through its commitment to nuclear nonproliferation and arms control by means of forward deployment of strategic bombers and fighter aircraft and the ability to posture nuclear weapons globally.[26] Forward deployment and force projection are strategic shows of force; the United States "will work with Allies and partners to identify opportunities to increase the visibility of US strategic assets to the region as a demonstration of US resolve and commitment."[27]

The *Strategy* calls for a force that is agile and responsive, meaning the Department of Defense "rapidly mobilizes forces, generates combat power, and provides logistics and sustainment, even given adversary regional advantages and climate change impacts."[28] Rapid mobilization of force enables contingency responsiveness and allows the United States to deter threats and assure Allies and partners.

Regarding contingency responsiveness, the position of the US government since the end of World War II is that preventing larger-scale attacks against Allies and partners requires forward presence—a ground force already in place to take immediate action.[29] This presence, enabled by strategic lift capabilities, promotes rapid response to conflict and crisis. Yet, climate change will impact in-theater resourcing. As one study states,

> if, instead, ground forces have to deploy from elsewhere by sea or air, even for relatively short distances, the advantage of forward presence will often be limited. . . . Beyond giving attention to specific major threats, the US defense strategy calls for a global response capability, so posture decisions should maintain an effective global en route infrastructure. The United States can maintain relatively rapid global response capabilities as long as this infrastructure and strategic lift assets are maintained.[30]

This is precisely the point of weakness identified by this study: by the year 2099, strategic lift assets will likely be substantially degraded, particularly those located in USAFRICOM and USSOUTHCOM. USNORTHCOM and USEUCOM show evidence of rapidly deteriorating conditions that while underwhelming by 2099, promise more substantial threat levels in years to follow. Although these commands may not be exceeding the

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26. Austin, *National Defense Strategy*.
27. Austin, 15.
28. Austin, 18.
29. Dave Shunk, Charles Hornick, and Dan Burkhart, "The Role of Forward Presence in U.S. Military Strategy," *Military Review* (July-August 2017), https://www.armyupress.army.mil/.
30. Michael Lostumbo et al., *U.S. Overseas Military Posture: Relative Costs and Strategic Benefits* (Santa Monica, CA: RAND Corporation, 2013), 1, https://www.rand.org/.

density altitude thresholds during the study period, they are approaching them at a more rapid pace when compared to the other four commands.

Deterrence and assurance are based on the United States demonstrating to a host region it is committed to the region's security and preservation. Forward presence of US forces and the capability to transport troops and equipment within a theater "show that the United States is willing to involve itself in conflicts to stabilize situations, secure US interests, and protect the global commons."[31] Global stationing of US troops is the physical demonstration and symbol of commitment to defend its Allies and partners, but also its ability to act against any nation or group that challenges that commitment. The US military cannot guarantee responsiveness if strategic lift assets are severely degraded throughout much, if not all, of the calendar year. The ability to respond to global demands quickly becomes contingent on the timing of those demands and the level of performance degradation associated with that timing.

National Defense Priorities and Regions of Interest

The 2022 *National Security Strategy* discusses the priorities for national security, including fostering a competitive edge over China and Russia and collaboration to address global food insecurity in places like sub-Saharan Africa.[32] The Indo-Pacific and European regions are additional likely locations for future US conflicts.[33] China, North Korea, Iran, and Russia each pose varying degrees of risk and threat to US security interests.[34]

Regarding the Middle East, this *Strategy* describes the need for the United States to continue its commitment to de-escalation of conflict in the region. The United States will "combine diplomacy, economic aid, and security assistance to local partners to alleviate suffering, reduce instability, and prevent the export of terrorism . . . while working with regional governments to manage the broader impacts of these challenges."[35]

The document reinforces that US involvement in the region no longer requires blanket use of offensive US military force, but rather support and backing for stability and prosperity built by regional partners:

> [US forces] have too often defaulted to military-centric policies underpinned by an unrealistic faith in force and regime change to deliver sustainable outcomes. . . . It is time to eschew grand designs in favor of more practical steps that can advance US interests and help regional partners lay the foundation for greater

31. Lostumbo et al., 2.
32. Joseph R. Biden Jr., *National Security Strategy* (Washington, DC: The White House, October 2022), https://www.whitehouse.gov/.
33. Raphael S. Cohen et al., *The Future of Warfare in 2030: Project Overview and Conclusions* (Santa Monica, CA: RAND Corporation, 2020), https://www.rand.org/.
34. Cohen et al.
35. Biden, *National Security Strategy*, 42.

> stability, prosperity, and opportunity for the people of the Middle East and for the American people.[36]

Regardless of whether US presence in the Middle East is offensive, defensive, or support-based, the need to maintain a military footprint in the region continues.

The national security priorities surrounding Africa include facilitating partnerships and providing aid to relieve food insecurity, health crises, and economic burdens.[37] Based on its longstanding role as a global leader, there is substantial pressure for the United States to intervene in instances of mass suffering and humanitarian crises.[38] Unfortunately, global climate warming will likely affect America's ability to carry out those missions.

The *Strategy* declares climate change to be "the greatest and potentially existential" shared challenge across all nations.[39] The document emphasizes that existing conflict and tensions will only worsen as they are compounded by the threats of climate change, including increased competition for resources, food insecurity, regional instability, and more frequent natural disasters.[40]

Combatant Command-Level Implications

While all six geographic combatant commands share the same strategic-level concern regarding increasing density altitude over the next century, the tactical impacts vary depending on the severity of each region during the warming period noted in this study. Combatant commands can expect to experience either mission-inhibiting levels of degradation during the warming period or a trajectory of rapidly deteriorating conditions that may manifest following the warming period included in this research.

USAFRICOM, USCENTCOM, USINDOPACOM, and USSOUTHCOM face serious degradation to airlift assets departing from within their geographic boundaries. The assessment presented in the results section was completed using C-17 specifications concerning takeoff weight reduction, but the principles learned from the study can and should be extended to what is to be expected with implications for landing weight, despite the specifications varying slightly due to required air speed. While tactical-level impacts are provided only for USAFRICOM, these four combatant commands face the most substantial year-round reduction in payload over the largest percentage of their land area.

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36. Biden.
37. Biden, 43–44.
38. Grant T. Harris, "Why Africa Matters to US National Security," Atlantic Council, May 25, 2017, https://www.atlanticcouncil.org/.
39. Biden, *National Security Strategy,* 9.
40. Biden.

USAFRICOM

The ability to efficiently provide future humanitarian support and aid to the African continent decreases substantially as 2099 approaches. Specifically, the USAFRICOM area of operations presents challenges to C-17 operations—a critical airpower element in humanitarian aid—due to particularly high density altitude conditions.[41] This threatens the US national security priority of providing humanitarian relief and support within the African continent. Operations will be significantly reduced in efficiency, and the time and resource expenditure required for these relief operations will increase substantially, both in terms of manpower and supplies.

Furthermore, even within the first portion of the warming period, 2020–2039, 94.4 percent of USAFRICOM is under a year-round 17.0 percent takeoff weight reduction, and 72.6 percent of the command is under a year-round 29.3 percent reduction. Tactically, this means that in nearly the entire combatant command, what previously would have required only five C-17 flights at maximum allowable payload would require an additional sixth flight to airlift the same total payload. And in approximately three-quarters of the command, every maximum payload for the C-17 would require about two flights. Although the ability to use the C-17 in a place such as USAFRICOM will not be lost entirely by 2099, it will be severely reduced in efficiency.

USCENTCOM

Iran, Iraq, and other countries within the boundaries of USCENTCOM are immediate regions of concern to US national security and will likely continue to be so through the end of the century.[42] Moreover, inherent strategic risk related to decreased lift capabilities will likely increase based on the large regions within the command that are subject to year-round weight limitations.

USINDOPACOM

USINDOPACOM has the potential to become an increased destination for US military forces, as the need to deter China continues to grow.[43] The very first defense priority listed in the *2022 National Defense Strategy* is to "[defend] the homeland, paced to the growing multi-domain threat posed by the PRC [People's Republic of China]."[44] China is cited as the "most consequential strategic competitor" that the United States is currently facing.[45] Therefore, any degradation experienced throughout the USINDOPACOM boundaries should be considered a critical-level threat to the national defense and se-

41. "C-17 Globemaster III: An Aircraft as Versatile as AE Crews," USAF Medical Service (website), accessed July 21, 2022, https://www.airforcemedicine.af.mil/.
42. Austin, *National Defense Strategy.*
43. Austin.
44. Austin, 7.
45. Austin, III.

curity of the United States, given the level of priority associated with combatting the threat from China.

USSOUTHCOM

Although there are only two ongoing conflicts in USSOUTHCOM of current concern to the United States, the command should remain on alert for any emerging conflicts in the region due to the severe degradation expected within the area of operations.

Conclusion

The Department of Defense must view climate change and global warming as tactical and strategic variables that threaten the military's ability to execute operations across the geographic combatant commands with the level of efficiency promised by its current aircraft and assured to its Allies and partners. USAFRICOM and USSOUTHCOM face climate change projections in a worst-case scenario (RCP 8.5) that render a significant majority of those commands in a critical degradation status by the year 2099. Such a scenario would place the C-17 Globemaster III under a 17.0 to 29.3 percent payload reduction year-round across nearly the entire land areas of USAFRICOM and USSOUTHCOM. USCENTCOM and USINDOPACOM trail closely behind.

USNORTHCOM and USEUCOM show evidence of substantially higher rates of density altitude increase relative to the other commands. By the year 2099, these two commands would make up a substantial majority of the top quartile for the distribution of values representing the percent increase in density altitude. While USNORTHCOM and USEUCOM might not be facing mission-inhibiting levels of degradation during the warming period included in this study, it is expected their degradation levels will continue to rise to the same level of severity seen in USAFRICOM and USSOUTHCOM as global warming continues to alter the operational environment.

Tactically, the Department should expect to sustain dramatic performance degradation to all aviation assets, most clearly evidenced by the decreasing thrust production that mandates reduced takeoff weight in strategic airlift platforms. While this study assumes the C-17 to be taking off with maximum allowable fuel, regional commanders will have the option to reduce takeoff weight by other means, such as less fuel on takeoff and increased utilization of aerial refueling assets. Commanders may also choose to sacrifice distance for payload. Reducing payload, then, is just one solution available to current and future commanders with regard to decreased aircraft performance in terms of total payload capacity.

Coping with this performance degradation will additionally fall on aircraft maintainers, aircrew mandated to fly extra missions, and taxpayers expected to help cover the added maintenance and operating costs.[46] The values of the density altitude thresholds are the

46. Ren et al., "Climate Warming."

only component of the data processing and analysis that is aircraft specific; different airframes within the Department of Defense or civilian aviation industry could be assessed in this same manner using new thresholds based on aircraft specifications.

The performance degradation of the C-17 Globemaster III, illustrated in this study, is only a small portion of the larger field of impact. Performance and capabilities of fighter, bomber, tanker, and rotary assets will also be diminished as the Earth continues to heat. Additional climate change scenarios may provide further opportunities for research and strategic planning. China and Russia may be the United States' regional and global competitors, but the universal adversary that is climate change knows no geopolitical boundaries.

Domain Restriction Zones

An Evolution of the Military Exclusion Zone

Cole M. Mooty
Robert A. Bettinger
Mark G. Reith

Since the early part of the twenty-first century, US adversaries have expanded their military capabilities within and their access to new warfighting domains. When faced with the growth of adversaries' asymmetric capabilities, the means, tactics, and strategies previously used by the US military lose their proportional effectiveness. To avoid such degradation of capability, the operational concept of the military exclusion zone (MEZ) should be revised to suit the modern battlespace while also addressing the shifts in national policy that encourage diplomacy over military force. The concept and development of domain restriction zones (DRZs) increase the relevancy of traditional MEZs in the modern battlespace, allowing them to address problems associated with cross-domain and multidomain capabilities. The growth of adversary capabilities provides a clear rationale for the implementation of DRZs through all levels of force application within the competition continuum.

Similar to its predecessor, the 2022 *National Security Strategy* prioritizes diplomatic resolutions over the potential direct application/threat of force, firmly emphasizing "using diplomacy to build the strongest possible coalitions," while ensuring military force is used as "a last resort."[1] Regardless, it remains the work of the Department of Defense to advance and safeguard vital US national interests by "backstopping diplomacy, confronting aggression, deterring conflict, projecting strength, and protecting the American people and their economic interests."[2] Warfighters must promote a Joint force that remains "lethal, resilient, sustainable, survivable, agile, and responsive," while able to support the American people in a manner beyond the greatest application of force: war.[3]

In accordance with US Air Force doctrine, this spectrum of conflict includes "a mixture of cooperation, competition below armed conflict, and armed conflict," encompassed

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1. Joseph R. Biden Jr., *National Security Strategy* (Washington, DC: The White House, October 2022), 16, 20, https://www.whitehouse.gov/
2. Biden, 20.
3. Biden, 21.

generally by the concept of the "competition continuum."[4] When taken in concert with national strategy, it is vital a Joint force uses a "wide variety of activities and roles that vary in purpose, scale, risk, tempo, and intensity"—specifically, tools capable of achieving national interests with efforts below the threshold of war.[5] Warfighters and policymakers alike should develop the means to pursue US security through the entirety of the competition continuum, while ensuring these means do not escalate conflict beyond their intended level of involvement.

Developing these methods requires planners and strategists recognize conflict in any form is inherently a competition—a competition in which the contenders are driven by action and counteraction in the totality of available warfighting domains. As one national security expert explains, "As competitors increasingly gain access to all domains of warfare, it becomes more likely that adversaries will seek to offset a competitor's dominance in one domain by acting more aggressively in another space."[6]

In the modern battlespace, adversaries have increased access to capabilities across all six domains of US military operations: subsurface naval, surface naval, ground, air, space, and cyberspace. Prevalent examples include the Islamic State of Iraq and the Levant's redoubled cyber operations against the West, the People's Republic of China's (PRC) expansion into the South China Sea, and Russia's Kosmos 2543 on-orbit antisatellite (ASAT) test in 2020.[7] Along the lines of these examples, as adversary technology and capabilities progress, it should be assumed that US multidomain accessibility will increasingly become contested rather than guaranteed.

Growth of adversary capabilities across the competition continuum and all domains has recently required the Joint force to prioritize multidomain operations, which "employ joint capabilities from all domains to complement and reinforce their own capabilities."[8] While the US military has devoted the majority of its "time, intensity, forces, etc." to the kinetic domination of an opponent "until the enemy is no longer able to effectively resist,"

4. US Air Force Chief of Staff, *The Air Force*, Air Force Doctrine Publication (AFDP) 1 (Maxwell AFB, AL: Curtis LeMay Center for Doctrine Development and Education, March 10, 2021), 2, https://www.doctrine.af.mil/.

5. Chairman of the Joint Chiefs of Staff (CJCS), *Joint Campaigns and Operations*, Joint Publication (JP) 3-0 (Washington, DC: CJCS, June 18, 2022), I-4.

6. James Jay Carafano, "America's Joint Force and the Domains of Warfare," Heritage Foundation (website), October 4, 2017, https://www.heritage.org/.

7. Stephen Burgess, "Confronting China's Maritime Expansion in the South China Sea," *Journal of Indo-Pacific Affairs*, August 31, 2020, https://www.airuniversity.af.edu/; Troy Smith, "The Specter of Cyber in the Service of the Islamic State: The Zeros and Ones of Modern Warfare," *American Intelligence Journal* 34, no. 1 (2017); and Neel V. Patel, "The US Says Russia Just Tested an 'Anti-satellite Weapon' in Orbit," *MIT Technology Review*, July 23, 2020, https://technologyreview.com/.

8. Headquarters, Department of the Army (HQDA), *Operations*, Army Field Manual (FM) 3-0, (Washington, DC: HQDA, October 2022), 2-15, https://armypubs.army.mil/.

the modern battlespace is increasingly characterized by actors working at different points along the continuum.[9]

Therefore the modern warfighter must also ensure the tools and capabilities at their disposal remain relevant through cooperation and competition below armed conflict, as well as in the direct application of force. While some tools that remain effective in nonkinetic portions of the competition continuum prove ineffective in armed conflict, the counterpoint remains equally true: the application of tools used to prosecute war could prove detrimental to military actions and efforts that fall below the threshold of armed conflict.

Reconciling the growth of adversary capabilities across all warfighting domains with the *National Security Strategy* raises a pertinent question: Are the tools the US military provides the Joint force capable of meeting threats across all domains, as well as across the entire competition continuum? This article seeks to take the existing strategy of exclusion zones traditionally used for single-domain control and adapt it into a broad means of addressing adversaries in all domains within a greater context of operations.

Existing Architectures: Historical Exclusion Zones

Although the number of domains and the tools used to access them have changed over time, the nature of conflict has always caused adversaries to seek new avenues to degrade their enemies' ability to operate within a given area. The use of military assets to perform these actions can be accomplished through a military exclusion zone (MEZ). In a notional sense, the historical use of MEZs can be grouped into three categories pertaining to three domains: a terrestrial MEZ, preventing access to a terrestrial location; a maritime MEZ, preventing access to some stretch of water; or an air exclusion zone (AEZ), colloquially referred to as a "no-fly zone." Each type of MEZ is implemented through various means, recognized within the international community with differing degrees of acceptance, and subject to specific legal and international conventions.

Terrestrial MEZs

Historical precedence. Terrestrial MEZs have the broadest grounding in historical precedence and have been implemented—to different degrees—in almost every conflict between state-level actors. Perhaps the most famous examples in modern history are the Berlin Wall and Korea's Demilitarized Zone/Joint Security Area: both zones created stark divisions between neighboring states, with the constant "possibility of death as a direct result of enemy action" and the "criminalization of entrance attempts" through direct, often lethal, enforcement of travel restrictions.[10] Historical examples of terrestrial MEZs

9. CJCS, *Joint Operations*, *Incorporating Change 1*, JP 3-0 (Washington, DC: CJCS, October 22, 2018), https://irp.fas.org/.

10. Klaus Schroeder and Jochen Staadt, "Todesfälle an der innerdeutschen Grenze und am Eisernen Vorhang bis 1989," Bundesministerium für Bildung und Forschung, December 31, 2016, https://www.bmbf

include border check zones, military-enforced security checkpoints, and closed cities, which are all zones or terrestrial regions that use military force to prevent direct access without proper approval. These exclusion zones have acted through the entire spectrum of the competition continuum, deterring adversary actions in engagements that fall below the threshold of armed conflict, and have served as launching or staging points for armed conflict.

Current implementation. Today, terrestrial MEZs are identified by the existence of standing occupational forces and the use of military forces in base and border security. Terrestrial MEZs are clearly defined regions of land that have restrictions on entrance and movement. These locations—actively patrolled, controlled, or guarded by military forces—host existing US, Allied/coalition partner, or regional/international organization forces such as NATO and are legally recognized in the international community.

Furthermore, their continued use has deterred adversary aggression and gambits for regional dominance, while also proving invaluable in regional stabilization and civil authority establishment. In various capacities, these terrestrial MEZs can be modeled by facilities that include Ramstein Air Base in Germany and Al Dhafra Air Base in the United Arab Emirates, each a functionally different but pivotal US Air Force resource that continues to operate across all warfighting domains. Defense and enforcement of these locations is traditionally reliant on conventional forces and weapons.

Legality and international considerations. Terrestrial MEZs are unique relative to other forms of the MEZ. The governing principles for these zones are defined by international humanitarian law and individual state regulations and laws. The actions of military forces stationed in and around these zones are clearly defined, forces are trained accordingly, and the right to enforce the zone is carefully considered against the principles of jus in bello and jus ad bellum, with a strong consideration for historical precedence set by existing MEZs.

Maritime MEZs

Historical precedence. As one study suggests, the history and legality of the maritime exclusion zone has evolved through three distinct phases.[11] The first phase of the maritime exclusion zone traces its roots to the Russo-Japanese War of 1904–1905. These "Phase I" maritime MEZs were "defensive in character, modest in size, and located adjacent to the State that authorized their creation."[12] These maritime MEZs have little comparative analytical value for a frequently expeditionary military such as the US Armed Forces. Such zones fill the niche of general deterrence while also supporting direct regional dominance of the enforcing nation.

.de/; and Rolf Potts, "Korea's No-Man's-Land," Salon, February 3, 1999, https://www.salon.com/.

11. Sandesh Sivakumaran, "Exclusion Zones in the Law of Armed Conflict at Sea: Evolution in Law and Practice," *International Law Studies* 92 (2016), https://digital-commons.usnwc.edu/.

12. Sivakumaran, 155.

The maritime MEZs next developed into Phase II, with areas "far larger in size than the exclusion zones of the Russo-Japanese War . . . located, in certain instances, at quite some distance from the coast of the State authorizing them."[13] Such Phase II zones were the first examples of maritime MEZs where any vessel within was deemed susceptible to attack, regardless of the vessel's belligerency or neutrality. The historical use of Phase II maritime MEZs is perhaps best exemplified in the German U-boat campaign of World War I, which acted to shape the warfighting environment through resource restriction, deter adversaries from engaging in the conflict, and seize the initiative for the German navy while actively dominating the Eastern Atlantic.

Current implementation. Phase III maritime MEZs are typically rooted in the changes to maritime law introduced by the *San Remo Manual on International Law Applicable to Armed Conflicts at Sea*, adopted in 1994.[14] The *San Remo Manual* established regulations for maritime MEZs and offers a definitive demarcation between their establishment and enforcement should they be created. The manual, though not internationally binding, has influenced doctrine in navies around the world. Specifically, the stipulation that "a belligerent cannot be absolved of its duties under international humanitarian law by establishing zones which might adversely affect the legitimate use of defined areas of the sea" has had a significant influence on the use of a Phase II-style maritime MEZ.[15]

The *San Remo Manual*, however, does not weigh in "on the inherent legality or illegality of exclusion zones, but regulates the zones in the event that the belligerents decide to create them."[16] As a result, Phase III maritime MEZs are typically subjected to, and judged with, individual consideration, specifically as their own terms relate to the rules of the law of the sea. In their current implementation, these Phase III maritime MEZs have been involved with elements of the competition continuum that fall at or above the threshold of armed conflict. These maritime MEZs are most readily applied by enforcing nations to seize the initiative from adversaries or dominate the targeted region directly.

Legality and international considerations. To determine the legality of maritime MEZs, the UN Convention on the Law of the Sea (UNCLOS) has two clauses of particular interest. The first is Article 88, which mandates that "the high seas be reserved for peaceful purposes" and seeks to guarantee "freedom of navigation, freedom of overflight, and freedom of fishing."[17] But this is restricted by Article 301, which allows the "exercise of conditions laid down by this Convention and by other rules of international law,"

13. Sivakumaran, 155.
14. Various authors, *San Remo Manual of International Law Applicable to Armed Conflicts at Sea, 12 June 1994* (International Institute of Humanitarian Law, Livorno, Italy, 1994), https://ihl-databases.icrc.org/.
15. *San Remo Manual*, 17, note 105.
16. Sivakumaran, "Exclusion Zones," 194–95.
17. UN General Assembly, United Nations Convention on the Law of the Sea (UNCLOS), December 10, 1982, https://www.un.org/.

effectively leaving the door open to consider exclusion zones, blockades, and associated measures as legitimate under the "rules in the law of armed conflict at sea."[18]

In general, the legal frameworks tied to maritime MEZs have continued to be unclear when the enforcing nation is required to defend their maritime MEZ's legitimacy within the realm of international law. One fact which rules supreme in international convention, however, is that a vessel's protection under international law, regardless of belligerency or neutrality, does not change simply because the vessel crosses an "imaginary line" constituting the boundary of a zone.

US implementation of maritime MEZs. The US military has incorporated the *San Remo Manual* approach to maritime MEZs, as noted in the 1997 and 2007 *Annotated Supplements to the Commander's Handbook on the Law of Naval Operations* published by the US Navy. The supplement notes that "such zones serve to warn neutral vessels and aircraft away from belligerent activities," and stipulates that "to the extent that they do not unreasonably interfere with legitimate neutral commerce, they are undoubtedly lawful."[19]

Air Exclusion Zone or No-Fly Zone

Historical precedence. The history of the air exclusion zone (AEZ) is significantly shorter than either the terrestrial or maritime MEZ. The first practical implementation of a no-fly zone is also arguably its most famous example: the post-1991 Gulf War no-fly zones over Iraq. Follow-on implementations of AEZs include coalition no-fly zones enforced over Bosnia and Herzegovina between 1993 and 1995 that included a UN Charter right for member states to "take all necessary measure to ensure compliance with the no-fly zone restrictions."[20] Recent examples of no-fly zones include AEZs enforced over Libya between 2011 and 2019.

Unilaterally, AEZs are characterized by a significantly more stringent implementation than maritime MEZs, defined by direct and often lethal use of force against any agent that violates the terms of the no-fly zone, regardless of belligerency or neutrality. This causes the legality of AEZs to be dubious at times and has brought into question the ethics of their implementation related to the potential loss of innocent life. It has furthermore severely limited the utility of an AEZ for cooperation and competition below armed conflict, as such rigid enforcement practically guarantees involvement beyond the threshold of armed conflict.

Current implementation. Contemporary no-fly zones are both a political tool and an implementation of direct military force. Though frequently enforced by the US military or some form of coalition forces, they are established by démarche. Current AEZs are

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18. UN General Assembly, UNCLOS*;* and Sivakumaran, "Exclusion Zones," 196.

19. A. R. Thomas and James C. Duncan, eds., *Annotated Supplement to the Commander's Handbook on the Law of Naval Operations* (Newport, RI: US Naval War College, 1999), 7.9, *International Law Studies* 73 (1997), https://archive.org/.

20. UN Security Council, Resolution 816, Bosnia and Herzegovina, March 31, 1993, S/RES/816 (March 31, 1993), https://www.refworld.org/.

implemented as either "declaratory policy, not subject to enforcement," or "operational policy, subject to enforcement and military action."[21] In general, no-fly zones are a clear departure "from traditional airpower missions by their imposition in another nation's airspace, absent of war, surrender, or occupation."[22] This distinct tie to the use of military force for the pursuit of national objectives below the threshold of war makes the AEZ a tool that can be expanded across the entire competition continuum.

Legality and international considerations. The implementation of no-fly zones traditionally occurs when the enforcing state invokes Article 42 of the UN Charter, a stipulation that the UN Security Council "may take such action by air, sea, or land forces as may be necessary to maintain or restore international peace and security."[23] The situation is complicated by the fact that "there are no existing legal definitions or criteria for a no-fly zone," and their establishment and enforcement lie ambiguously in the realm of permissibility—they are neither explicitly allowed nor explicitly denied by international convention, leaving their legality up to case-by-case interpretation.[24]

The legality of an AEZ is determined by the UN Security Council, frequently well after such a zone's establishment: the Gulf War no-fly zone is a clear example of such rulings. Though invoked as part of UN Charter Article 42, the 2003 UN secretary general deemed the no-fly zone was illegal as well as not directly authorized 12 years after the zone's establishment. This places no-fly zones in a similar position as maritime MEZs, lacking explicit approval or denial, but with noticeably less international and historical precedence to guide an enforcer's actions.

US implementation of AEZs. The US military recognizes that a "no-fly zone is a *de facto* aerial occupation of sovereign airspace in which . . . only aircraft of the enforcement forces may fly."[25] In terms of strategy, however, no-fly zones have had questionable effects. The AEZ as a tool is not constrained by its military utility, but rather by its management, institution, and prosecution by policymakers and warfighters that seek to achieve that which an AEZ is not made to do.[26]

Understanding the regional impacts of an AEZ prevents such a tool from overriding or harming national interests once direct armed conflict ceases and regional stabilization and transition to civil authority return. These requirements are compounded by the fact that "a no-fly zone relies on . . . conventional deterrence backed by the resolve to swiftly

21. Jan-Marc Jouas, "No-Fly Zones: An Effective Use of Airpower, or Just a Lot of Noise" (research report, US Air Force Academy, January 6, 1998), 2, https://apps.dtic.mil/.

22. Jouas, 2.

23. UN General Assembly, UN Charter, signed June 26, 1945, https://www.un.org/.

24. Jouas, "No-Fly Zones."

25. Michael M. Schmitt, "Clipped Wings: Effective and Legal No-Fly Zone Rules of Engagement," *International Law Studies* 72 (1998): 240, https://digital-commons.usnwc.edu/.

26. Alexander Benard, "Lessons from Iraq and Bosnia on the Theory and Practice of No-Fly Zones," *Journal of Strategic Studies* 27, no. 3 (September 2004), https://papers.ssrn.com/.

and ferociously enforce it if challenged."[27] In the face of antiaircraft artillery, man-portable air defense, or advanced surface-to-air missile systems, enforcing no-fly zones in this manner becomes "neither operationally feasible nor politically appetizing."[28] The utility of an AEZ is much more questionable than that of a terrestrial MEZ or maritime MEZ, especially in an environment where direct application of force is unappetizing.

A Military Exclusion Zone Overview

The key attributes of an effective military exclusion zone are defined as follows:

Observable targets. In 1978, the first protocol addendum to the Geneva Conventions of 1949 rightfully led to "the prohibition of indiscriminate attacks" in "international and non-international armed conflicts."[29] As MEZs inherently result in the targeting of any force entering a specific region, reducing collateral damage mandates that targeted assets be clearly defined and observable. This is even more important in modern combat, where assets act in, and threaten across, multiple domains in conditions of compressed time and increased lethality.[30]

Looking forward, effective MEZ implementation will require planners and strategists to "solve the physics of this expanded battlespace and understand the capabilities each domain can provide," rather than simply define generic target assets. Whereas the previous definition of a military exclusion zone could be as generic as a no-fly zone, the modern MEZ requires details such as the target aircraft type and capability.[31] A properly defined target might be a fighter aircraft capable of supersonic flight and carrying munitions, which could be identified through available sensors and detection technology.

Boundaries. A successful MEZ clearly defines its boundaries.[32] Furthermore, an effective MEZ should "represen[t] these elements in a physically based framework" to clarify "an already very complex multi-domain operating environment."[33] Fundamentally, for a modern MEZ to prove successful, it should definitively lay out the physical space within which it functions. These boundaries should be distinct and internationally recognizable, such as a certain radius from a given latitude and longitude point, or a geographically defined space an aircraft could overfly.

27. Mike Benitez and Mike Pietrucha, "The Dangerous Allure of the No-Fly Zone," War on the Rocks, March 4, 2022, https://warontherocks.com/.

28. Benitez and Pietrucha.

29. International Committee of the Red Cross, "Protocol II to the Convention on Certain Conventional Weapons, Article 3(3)," Committee on International Humanitarian Law, October 1986.

30. US Army Training and Doctrine Command (TRADOC), *Multi-Domain Battle: Evolution of Combined Arms for the 21st Century, 2025–2040*, Version 1.0 (Fort Eustis, VA: TRADOC, December 2017), i, https://www.tradoc.army.mil/.

31. TRADOC, ii.

32. TRADOC, 8.

33. TRADOC, 8.

Communication. Across the board, military exclusion zones require clear communication of intent to all involved parties. Today's adversaries "challenge the traditional metrics of deterrence by conducting operations that make unclear the distinctions between peace and war."[34] The enforcing party and parties involved—willingly or not—with or contained within the zone must communicate directly and clearly. The battlespace of the late twentieth century to today contains a dynamic mixture of state and nonstate actors, both potential targets within an MEZ; as such, enforcement is crucial. Perhaps the cleanest example of effective communication is the announcement and subsequent enforcement of AEZs over Bosnia in the 1990s and Libya in the 2010s, where clear target and location definitions were communicated and prosecuted.

Flexibility. The modern Joint force is focused on "deterring escalation through the application of flexible deterrent options"; a successful MEZ, as part of this Joint effort, must be sufficiently flexible, adapting to changing actors within the zone.[35] Aircraft, depending on the platform, could also serve other purposes, including transportation of personnel and goods, so defining a method for such an asset to selectively operate within the MEZ is important. A waiver mechanism capable of allowing actions for recognized parties, specifically actions prohibited by the type of MEZ in consideration, would be invaluable in the successful prosecution of the desired end-state of the zone.

Mediation. The successful mediation of an MEZ requires two specific developments. First, to abide by international convention, the laws of armed conflict, and the accepted morality of war, there must be a means to de-escalate violent enforcement. For an MEZ to fulfill its role of controlling "the escalation and de-escalation of crisis," across the continuum of competition including reducing collateral damage, there must be a defined, routine, nonviolent method of resolving infractions in addition to the kinetic enforcement.[36] Second, an MEZ must have a defined, nonviolent resolution or exit strategy. De-escalation of an MEZ ensures that final de-escalation "maintains or improves conditions favorable to US interest."[37]

Current Military Exclusion Zone Limitations

The understanding and execution of military exclusion zones are limited to four of the six warfighting domains available. Applying MEZ tools in today's battlespace, however, necessitates changes to nomenclature and enforcement to permit flexibility across all domains. The US position of power is jeopardized when an adversary's asymmetric capabilities allow it to distract or detract from US control in another domain; changing the way the United States implements MEZs to address this lack of context on the warfighting scale is the next step.

34. TRADOC, 2.
35. TRADOC, 21.
36. TRADOC, 5.
37. TRADOC, 46.

Additionally, current MEZs are inherently limited by the geographic domains they encompass. Multidomain weapons used by US adversaries are not countered by the geographic boundary requirements of a military exclusion zone. Current MEZ architectures may address some cross-domain capabilities such as maritime MEZs, which frequently also restrict the airspace above their maritime locality. MEZ enforcement, however, is ineffective at restricting asymmetric influence from domains that chafe against traditional physical definitions—that is, space and cyber architectures. The specificity of a military exclusion zone to the domain within which it is employed severely limits the ability of the MEZ to degrade an adversary's cross-domain capabilities. This is true even if the zone is employed across all four historically involved domains—for example, the total exclusion zone as implemented by the United Kingdom during the Falkland War. Among other effects, communications, transportation of resources, and intelligence-gathering sources increasingly span numerous domains, further requiring a redefinition of the traditional MEZ.

In addition to geography, these zones are limited by the nature of the domain they target. As noted, a successful MEZ requires definable, observable targets. The zone actors, assets, and potential targets within the four historical domains are physical in nature and therefore subject to observation and classification. The modern battlespace, however, is not entirely classifiable in a physical sense. Although certain targets in the space domain are physical in nature and can be observed, the same cannot be directly extended to cyberspace. In particular, the cyber domain is still in the fledgling stages of both development and understanding: The inherent agility, flexibility, and pure adaptability of cyber domain maneuvering require that targets be treated differently than other domains.

Domain Restriction Zones

This article contends the concept of an MEZ may be applied more broadly, and that a novel domain restriction zone (DRZ) should be designed to flexibly exert tools of national power through any domain or combinations of domains against a desired adversary (fig. 1).

Defining these restriction zones comes as a function of five key domains: a land DRZ that would be the modern application of a terrestrial MEZ; a sea DRZ that would be the modern application of a maritime MEZ (for both the naval surface and naval subsurface domains); an air DRZ that would be the modern application of an air exclusion zone; and the new additions of space and cyberspace DRZs that extend the concept of an MEZ into domains to which it has yet to be applied. The first three of these principally involve a rebranding and do not require further definition or explanation. Space and cyberspace DRZs, however, are a new concept.

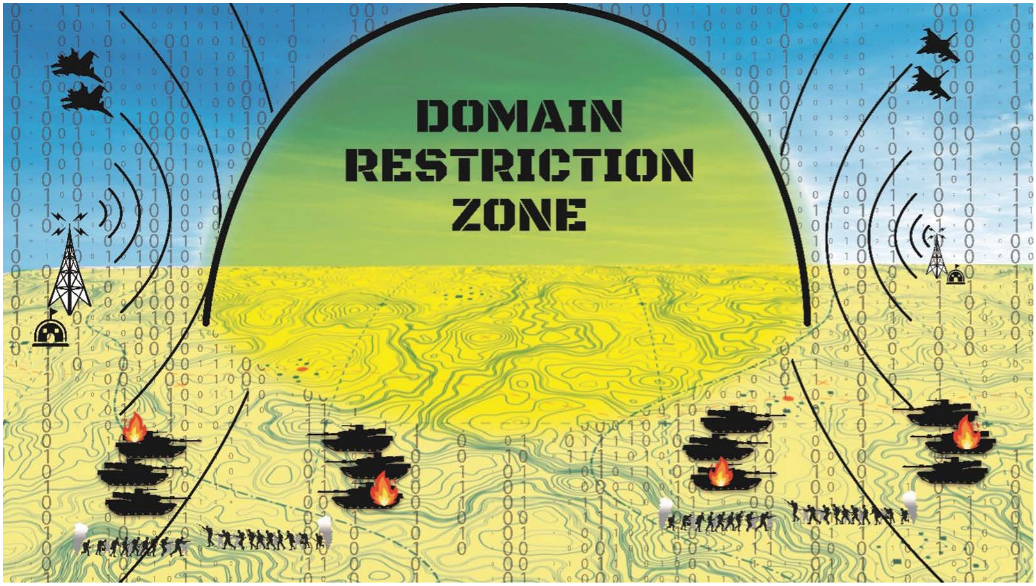

Figure 1. A notional domain restriction zone

Space Domain Restriction Zone

The space domain has two key differences relative to the other domains. These differences relate directly to the nature of historically successful MEZs and lead to some different attributes necessary for success.

Boundaries. First, space DRZ boundaries cannot be determined in a geographical manner. Space is an inherently mobile domain, with existing satellite architectures moving along their orbits. Defining a domain restriction zone in purely geographic terms would require the direct threat of destruction to any and all satellites whose orbits overfly the geographic zone, regardless of the capabilities they possess. A space DRZ is, therefore, more readily defined as a cross-reference between capabilities and locations. Whereas an air DRZ would prevent overflight within a certain defined region, a space DRZ would reduce or remove an adversary's space-based capabilities—such as communications, imagery, or positioning information—within that region, rather than space-based assets.

Observable targets. Second, the scale of the assets and systems in play in space is significantly greater than those in other domains. Space architectures are expensive relative to assets in other domains due to space-lift costs and the inability of asset servicing, necessitating complex, high-value systems for continued on-orbit missions' operations for years or even decades. Furthermore, space assets are often strategic in nature. Threats against strategic assets, in any capacity, are universally seen as a touchpoint for war, further raising the stakes of emplacing a space DRZ relative to other domains. Red lines that, if crossed, could lead to international conflict must be closely observed so that using a space DRZ does not cause direct escalation to war.

Tools to employ. Although the tools and assets that would be used to enforce land, sea, and air DRZs are already well defined—that is, surface-to-air missile systems, mines, guarded fortifications, and others—the tools used to enforce a space DRZ are less so. Understanding the enforcement tools will also further clarify how the zone itself should be defined. These tools include "extant capabilities to deny, disrupt, or physically destroy space systems."[38] They are traditionally identified as offensive counterspace capabilities, which include denial and deception measures, electronic warfare capabilities, ground station attacks, space mines, and both co-orbital and direct-ascent ASAT weapons.[39]

- **Denial and deception.** Actors can enforce space DRZs by directly defeating satellite "orbital and sensor characteristics."[40] Knowledge of an asset's capabilities, specific sensors and equipment, and critical sensor usage times allow the DRZ enforcer to pinpoint not just the physical asset, but specific effects. Examples of service denial include satellite dazzling or blinding of satellite sensors/payloads; spoofing, or the insertion of "fake instructions" to a satellite; and effects specific to the targeted system, or "selective availability," which is the targeted accuracy reduction of GPS signals.[41] In general, any means of denying the adversary's use of sensors or the quality and accuracy of the data collected may be effective ways to enforce a space DRZ.
- **Electronic warfare.** The majority of commercial and civil satellites do not have built-in protection capabilities and are vulnerable to electronic jamming capabilities that can disrupt their bus and/or payload functions.[42] A prime example of this form of offensive counterspace is GPS jamming. As identified by one study, "the weakness of GPS signals . . . provides a range of opportunities for criminals, terrorists and state actors using GPS jamming devices."[43] Analogous to terrestrial jamming, electronic warfare provides less kinetic means of restricting space architectures.
- **Ground station attack.** Offensive counterspace capabilities are not limited to targeting the satellite and on-orbit architecture. An alternate method for disrupting and/or degrading space architectures, thus avoiding the need for accurate targeting or more advanced weapons systems, is to attack the ground station(s). Though simplistic and limited by the increasing scope and accessibility of space architectures in general, strikes ranging from physical attacks to the intrusion of computer

38. Commission to Assess United States National Security Space Management and Organization [Space Commission], *Report to the Commission to Assess United States National Security Space Management and Organization*, January 11, 2001, viii, https://spp.fas.org/.

39. Space Commission.

40. Space Commission, 19.

41. Bruce M. DeBlois et al., "Space Weapons: Crossing the U.S. Rubicon," *International Security* 29, no. 2 (2004): 57, http://www.jstor.org/.

42. Space Commission, *Report,* 19.

43. Tegg Westbrook, "The Global Positioning System and Military Jamming: Geographies of Electronic Warfare," *Journal of Strategic Security* 12, no. 2 (2019): 1, https://www.jstor.org/.

networks provide an easily accessible manner of disruption.[44] Such attacks prove effective against adversaries with limited space accessibility—such as insurgencies and terrorist organizations—or low resiliency in space command-and-control architectures.

- **Space mines and co-orbital ASATs.** Satellite proximity operations are another way to enforce a space DRZ. Employing small explosive devices or kinetic/directed energy weapons on-orbit enables the DRZ enforcer to physically threaten an adversary's space systems. While the concept of space mines represents a broad spatial threat against the orbital regime targeted by the DRZ, the use of co-orbital ASATs could provide a means for guided close-in intercept to yield a potentially "fatal collateral blow to the satellites intended" or to force an adversary to maneuver to avoid collision.[45] The threat of these techniques, and the likelihood they would cause conflict escalation, is likely greater than that of the denial, deception, or electronic warfare methods, which yield more transient effects on targeted assets.
- **Direct-ascent ASAT capabilities.** A no-fly zone is characterized by direct, often lethal, engagement of force against adversary forces violating the region. This translates directly into the space DRZ as the direct-ascent ASAT mission, which uses a ground-, sea-, or potentially air-based system to destroy an adversary's space-based asset. And similar to space mines and co-orbital assets, these technologies have the potential to trigger broader conflict.[46]

Cyberspace Domain Restriction Zone

Cyberspace is an even less defined or constrained domain than space, affecting global society and critical infrastructure.[47] A general restriction of an adversary's access to cyberspace, as the traditional interpretation of an MEZ requires, is impractical for three reasons innately tied to the differences between the cyber domain and other domains.

Boundaries. First, a total cyberspace phase restriction is infeasible to enforce, as its scope and breadth is tied so deeply into every aspect of modern life. Cyberspace as a domain cannot be delineated by geography or cleanly cut into sections that interact with each other. Rather, it is integral to the information environment. Cyberspace "continuously

44. Space Commission, *Report*, 19.
45. DeBlois et al., "Space Weapons."
46. Kurt Gottfried and Richard Ned Lebow, "Anti-Satellite Weapons: Weighing the Risks," *Daedalus* 114, no. 2 (1985): 168, https://www.jstor.org.
47. Nick Ebner, "IFAR Fact Sheet: Cyber Space, Cyber Attack, and Cyber Weapons: A Contribution to the Terminology" (paper, Institute for Peace Research and the Security Policy at the University of Hamburg, October 2015), 1, https://ifsh.de/.

interacts with individuals, organizations, and systems" across dimensions that meld between "the physical, informational, and cognitive."[48]

Observable targets. Second, potential targets in cyberspace differ from those of the other domains. Though this domain contains observable targets such as the infrastructure and systems through which cyberspace maneuvering is accomplished, the cognitive and informational aspects are less conventionally observable. Cyberspace requires users to understand the movement of "content and code between humans and machines with the goal of getting them to act"—chiefly to act in a manner beneficial to the enforcer.[49] Finally, the cyber domain is characterized by agility; efforts to restrict movement lead to adversary adaptation—likely at a rate much greater than the enforcer's ability to restrict. The "continuous intertwining of cyberspace and human activity," as well as the agility of content and code as it pertains to shaping action, makes clear target definition in the cyber domain vastly different than target refinement in other domains.[50]

Flexibility. Third, the range of the cyberspace domain ensures that domain restrictions could include persistent comprehensive attacks on national and international security.[51] With this in mind, one should recognize cyberspace operations have traditionally sought to "disrupt and/or destroy an adversary's critical cyber systems, assets, or functions."[52] This highlights a key consideration that should be carefully evaluated for a cyberspace DRZ: collateral damage. Enforcement of restrictions on an adversary's cyberspace capabilities has the potential to adversely affect those who are not targets of the restriction; such actions must avoid being "excessive in light of the overall military advantage anticipated."[53] To mitigate collateral damage associated with cyber activities, the flexibility of actions in the cyber domain requires more consideration than other domains.

Tools to employ. Joint Publication 3-12, *Cyberspace Operations*, identifies three primary core cyberspace activities: military operations in and through cyberspace, national intelligence operations in and through cyberspace, and DoD "ordinary business operations in and through cyberspace."[54] The first of these core activities provides a ready reference for DRZ enforcement mechanisms available to the US military.

- **Civil operations.** The Department of Homeland Security is responsible for "strengthening cybersecurity resilience across the nation and sectors, investigating

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48. Richard Crowell, "Some Principles of Cyber Warfare—Using Corbett to Understand War in the Early Twenty-First Century" (Corbett Paper No. 19, King's College London, Corbett Centre for Maritime Policy Studies, January 2017), 3–4, https://www.academia.edu/.

49. Crowell, 4.

50. Crowell, 4.

51. Ebner, "IFAR Fact Sheet."

52. James Cartwright, "Joint Terminology for Cyberspace Operations," memorandum, Vice Chairman of the Joint Chiefs of Staff, August 18, 2009, https://info.publicintelligence.net/.

53. Cartwright.

54. CJCS, *Cyberspace Operations*, JP 3–12 (Washington, DC: CJCS, June 8, 2018), II-9, https://info.publicintelligence.net.

malicious cyber activity, and advancing cybersecurity alongside our democratic values and principles."[55] One subordinate agency, the Cybersecurity and Infrastructure Security Agency, is the nexus for coordination and information across public and private entities. This agency is positioned to work with sovereign counterparts and international telecoms to observe activity in a defined cyber domain restriction zone.[56]

Consider a commercial datacenter in a neutral country or a geographical area where wireless emanations are highly regulated. Parties to a cyberspace DRZ agreement might send civil representatives to observe operations, signals, and data flow to provide transparency and assistance in securing the agreed-upon DRZ. This cooperative effort could ensure adversary military resources and activities are absent and increase the likelihood that third-party operatives are also excluded. This approach would primarily occur before conflict and likely require similar laws across all parties and the neutral host in order to leverage the civil legal and policing capabilities. As the situation escalates, a sovereign country might transition to military operations.

- **Military operations.** The tools available to enforce a cyberspace DRZ fall under the umbrella of two different operations: cyberspace exploitation and cyberspace attack. Cyberspace exploitation includes "military intelligence activities, maneuver, information collection, and other enabling actions."[57] Exploitation typically relates to discovering vulnerabilities, enabling target development, and supporting the planning, execution, and assessment of military operations. This probing and determination step is invaluable to planning relevant cyberspace attack follow-ons that enforce the desired capability restrictions of the cyberspace DRZ.

  Cyberspace attack is focused on the two primary efforts of service denial and service manipulation. To deny, the US military attempts to "prevent access to, operation of, or availability of a target[ed] function by a specific level for a specific time," through the means of degradation, disruption, or destruction.[58] Note that disruption is the case where degradation is set to a level of 100 percent for the desired span of time, while destruction is a relative term as the majority of cyberspace targets are subject to reconstitution with sufficient time and resources.

  The techniques here range widely in potential and include network throttling, such as the intentional degradation of internet speed and web performance; denial of service attacks; man-in-the-middle attacks; malware attacks; ransomware; URL interpretation; DNS spoofing; transmission interruption; jamming of signals; and a whole host

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55. US Department of Homeland Security (DHS), "Cyber Mission Overview," DHS (website), October 3, 2022, https://www.dhs.gov/.
56. DHS.
57. CJCS, *Cyberspace Operations*, II-6.
58. CJCS, II-7.

of other offensive capabilities.[59] The nature of cyberspace attack makes the enforcement of these restrictions a very flexible, dynamic process.[60]

Employing domain restriction zones to create restrictions across multiple domains will increasingly become a requirement in order to successfully counter adversary multidomain weapons systems and capabilities. For example, a DRZ could restrict a targeted nation's communications capabilities. Such an operation would require presence in no less than four domains—land, air, space, and cyberspace—restricting the targeted nation's potential communication capabilities across these nonmaritime domain distinctions (fig. 2). This means of selecting both a capability to restrict and a region or space within which to restrict it is paramount to not only space and cyberspace DRZs in particular, but also the concept of a DRZ in its totality.

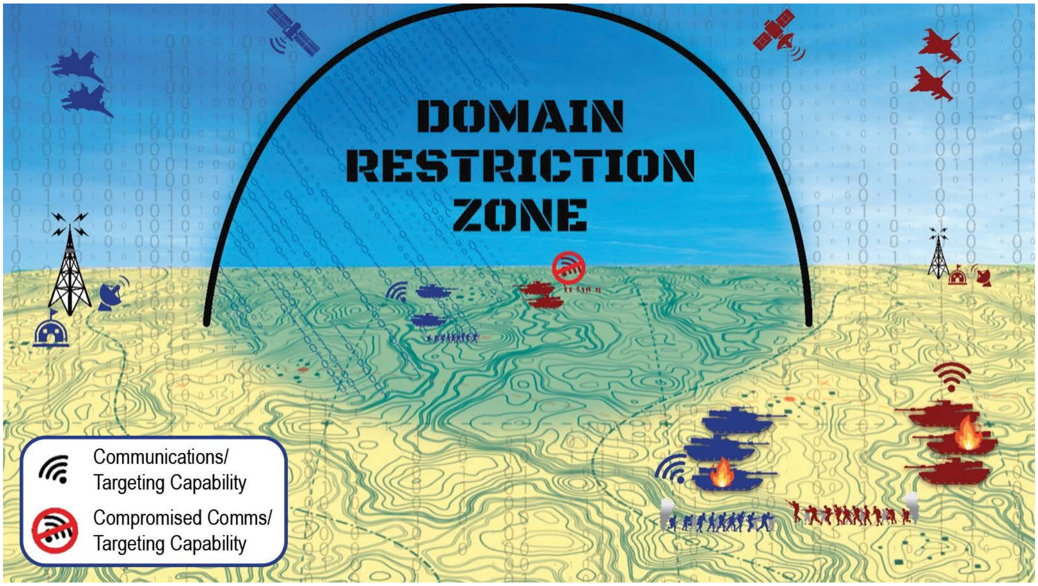

Figure 2. A notional domain restriction zone restricting adversary communication capabilities across land, air, space, and cyberspace, within a nonmaritime geographic location

Cross-referencing figures 1 and 2 against the current operational planning phase framework demonstrates the flexibility and utility this framework provides for a tool such as a domain restriction zone. First, a DRZ can produce the same effects as a military exclusion zone across domains: By enforcing limitations on space operations enforcement

59. FortiGuard Labs, *Global Threat Landscape Report: A Semiannual Report by FortiGuard Labs*, Fortinet (website), February 2022, https://www.fortinet.com/.

60. Brandon Valeriano and Benjamin Jensen, "The Myth of the Cyber Offense: The Case for Restraint," Cato Institute, January 15, 2019, https://www.cato.org/

mechanisms and shaping opponent action through cyberspace attack and exploitation, the DRZ could deter and/or incapacitate enemy forces in a given region. By targeting all enemy capabilities, a DRZ focused on total cyberspace restriction could produce an optimal environment within which to operate or stabilize a region while ensuring the development of a reliable civil authority.

When one of the involved parties seeks to seize the initiative in conflict or dominate a given region, the ability to target a given capability in that region, such as communication or targeting capabilities, is critical. Figure 2 highlights the benefits of changing an MEZ model toward a DRZ focus. By cross-referencing a desired capability restriction with the physical region targeted, a DRZ would prove a decisive factor in engagements within the targeted region.

Instead of focusing on force exclusion—the prevention of enemy presence and action in a region—a DRZ focuses on the capabilities, seeking to shape adversary action by limiting an adversary's warfighting ability, guiding the manner in which such an engagement would be prosecuted, and applying general pressure to belligerents in and around the targeted location. The domain restriction zone answers the shortcomings of the military exclusion zone problem by providing flexibility, adapting to domains where exclusion is infeasible, and targeting capabilities rather than assets. This combination makes an increasingly irrelevant tool practical for the modern warfighter.

Conclusion

Military exclusion zones have historical and military precedent as wartime and peacetime tools. Yet MEZs increasingly have reduced utility due to interdomain ties and the movement of assets and capabilities into domains not covered by MEZ architectures. Eliminating this tool is impractical and detrimental to planning for the contemporary battlespace; instead it must be adapted, particularly as existing MEZ considerations can simply be pivoted to a more relevant model: the domain restriction zone. Applying the idea of domain restrictions zones to certain targeted adversary capabilities provides the path forward for the traditional MEZ and offers a revitalized tool to policymakers and war planners. The flexibility gained by the multidomain approach, the dynamics available when targeting desired capabilities, and the focus on managing the escalation of force fits the DRZ into a greater context of the competition continuum while keeping it grounded in international precedence and reasonability.

Targeting Dual-Use Satellites

Lessons Learned from Terrestrial Warfare

Jennifer A. Cannon

The United States, its Allies, partners, and other space powers are increasingly relying on dual-use satellites for national security and defense, raising questions about the implications for targeting such assets as part of current and future warfare. Three case studies of terrestrial attacks on dual-use targets extrapolate strategic, operational, and legal issues that could arise from attacks on dual-use satellites in space.

This article addresses a research gap in the studies of geopolitical and operational implications for intermingling commercial space capabilities and services with military operations and their derived effects. Other research has delved into the legal consequences of dual-use satellites—satellites that can serve both civil and military purposes—based on international treaties, space law, and international humanitarian law.[1] Instead, this article will focus on the operational and strategic impacts of spacefaring nations' increased development of dual-use satellites. Reviewing outer space treaties and international law, the research will consider examples of previous attacks on terrestrial dual-use targets to suggest possible implications of attacks on dual-use satellites.

This analysis includes three case studies: the 1999 attacks on Serbian targets by NATO during Operation Allied Force, the 2021 attack on the Al-Jalaa tower in Gaza by the Israeli Defense Forces, and the Russian Federation's current attacks against dual-use infrastructure in Ukraine. Each case study considers three independent variables—geopolitical/strategic implications of the strikes, operational consequences, and adherence to international humanitarian law—revealing consequences for using and striking dual-use satellites, especially as they relate to international humanitarian law, also called the law of armed conflict (LOAC).

Certainly, collateral damage—unintentional harm to civilians—from terrestrial attacks differs from collateral damage in outer space; accordingly the most recent attacks on satellites supporting the war in Ukraine can predict future impacts to noncombatants from such strikes. Although the strategic implications of strikes on dual-use targets might be similar in outer space and on land, the impacts on collateral damage and related concerns connected to international humanitarian law are largely unknown in the operational space domain.

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1. Kenneth R. Rizer, "Bombing Dual-Use Targets: Legal, Ethical, and Doctrinal Perspectives," *Air & Space Power Journal* Chronicles, May 1, 2001, https://www.airuniversity.af.edu/f; Ross Brown, "Conflict on the Final Frontier: Deficiencies in the Law of Space Conflict below Armed Attack, and How to Remedy Them," *Georgetown Journal of International Law* 51, no. 1 (Fall 2019); and P. J. Blount, "Renovating Space: The Future of International Space Law," *Denver Journal of International Law and Policy* 40, no. 1 (January 2011).

Current Outer Space Dual-Use Capabilities and Policy

An increasing number of security organizations and space powers, including NATO, the United States, China, and the Russian Federation, accept that dual-use satellites are critical to national security. On February 15, 2023, 16 NATO countries, along with Sweden and Finland, announced an Alliance Persistent Surveillance from Space initiative that would integrate commercial and national space sensors to significantly improve NATO's intelligence, surveillance, and reconnaissance capabilities.[2] This integration of commercial and national sensing assets is a notable example of Allies using dual-use space capabilities for national and collective security. In this article, dual-use objects refers "to objects which qualify as a military objective under international humanitarian law, but which also simultaneously serve civilian functions."[3]

These technologies are not new. As one space policy expert explains, these "fundamental space technologies created by the military-industrial complexes of the Second World War and the Cold War committed space technology's original sin as a tool for warfare, intelligence gathering, and self-interested political-economic power."[4] Using commercial or civil assets alongside national assets in space allows the developers to save resources by sharing time and space on costly launches and capabilities.

According to the 2021 *US Space Priorities Framework,* the United States "will leverage new commercial space capabilities and services to meet national security requirements and will deepen the integration of U.S. national security space capabilities and activities with those of [its] allies and partners."[5] Although this verbiage does not specify the increased procurement of dual-use satellites or additional capabilities for existing ones, it suggests leveraging commercial capabilities for national security means is critical. For the US military, integrating military and commercial satellites into this hybrid construct is necessary for sufficient capacity and redundancy in times of crisis.[6]

Moreover, the recent examples of the employment of dual-use satellites in Ukrainian military efforts and the increase in funding of American, NATO, and partner commercial/military hybrid constellations reinforce the fact that US decisionmakers, strategists, and planners must understand the implications of using these satellites in future conflicts.

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2. North Atlantic Treaty Organization (NATO), "16 Allies, Finland and Sweden Launch Largest Space Project in NATO's History," NATO (website), February 23, 2023, https://www.nato.int/.

3. Maurice Cotter, "Military Necessity, Proportionality and Dual-Use Objects at the ICTY: A Close Reading of the *Prlić et al*. Proceedings on the Destruction of the Old Bridge of Mostar," *Journal of Conflict and Security Law* 23, no. 2 (2018): 297, https://doi.org/.

4. Bleddyn Bowen, *Original Sin*: *Power, Technology, and War in Outer Space* (New York: Oxford University Press, 2023), 3.

5. The White House, *United States Space Priorities Framework* (Washington, DC: The White House, December 2021), 6, https://www.whitehouse.gov/.

6. John Goehring, "The Legality of Intermingling Military and Civilian Capabilities in Space," Lieber Institute – West Point, October 17, 2022, https://lieber.westpoint.edu/.

International Law

Treaties

The five primary UN treaties relating to outer space include the Outer Space Treaty (OST), the Rescue Agreement, the Liability Convention, the Registration Convention, and the Moon Treaty.[7] Of these, the OST is the most relevant document related to the exploration, scientific use, and application of outer space for national security. Legal and policy scholars have dissected this document for academic, operational, strategic, and legal decisions related to offensive and defensive attacks in outer space, with one leading legal scholar noting it is the most comprehensive treaty applicable as a "quasi-constitution for space."[8]

Article III of the treaty states that international law extends to outer space. Therefore, international humanitarian law should apply when considering states' use of outer space for national security matters, although it is important to note that even the *Oslo Manual on Select Topics on the Law of Armed Conflict* has observed that "in the absence of sufficient state practice and *opinio juris*, the application or interpretation of LOAC in Outer Space may be subject to controversy."[9]

Regarding weapons in outer space, Article IV of the Outer Space Treaty notes that states "undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction."[10] Since the OST entered into force, other types of weapons—directed energy, kinetic (antisatellite), electronic attack, cyber—that are not considered weapons of mass destruction have been put into orbit around Earth.[11] In the current strategic and technological environment, the OST cannot preclude state and nonstate actors from putting any weapons except weapons of mass destruction into orbit.

Article VI of the treaty is also relevant to attacks in outer space. It states that parties "shall bear international responsibility for national activities in outer space . . . whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth

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7. United Nations Office for Outer Space Affairs (UNOOSA), "Space Law Treaties and Principles," UNOOSA (website), n.d., https://www.unoosa.org/.

8. Bonny Birkeland, "Space: The Final Next Frontier Note," *Minnesota Law Review* 3260 (2020): 2067.

9. Yoram Dinstein and Arne Willy Dahl, *Oslo Manual on Select Topics of the Law of Armed Conflict: Rules and Commentary* (Cham, Switzerland: Springer International Publishing, 2020), § 1, Rule 2, 3–4, https://doi.org/; and Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty), opened for signature January 1967, UN RES 2222 (XXI).

10. Outer Space Treaty.

11. Department of Defense (DoD), *Defense Space Strategy Summary* (Washington, DC: DoD, June 2020), 4, https://media.defense.gov/.

in the present Treaty."[12] One analysis maintains that Article VI considers commercial actors in space, pointing to language that says states are responsible for nongovernmental actors' behaviors.[13] This interpretation is critical when analyzing the implications of the United States and its partners' increased desire to utilize dual-use satellites for national security.

Law of Armed Conflict/International Humanitarian Law

The United States, its Allies, and its partners treat the law of armed conflict—a collection of international treaties and customary international law—as a source of significant authority in military interventions and war. [14] The American military applies LOAC based on international treaties, including the 1949 Geneva Conventions, customary international law, and domestic laws and regulations.[15] Based on this set of treaties and customary laws, many states and organizations, including the United States and its Allies, have begun extrapolating laws applicable to outer space, recently named the US military's newest warfighting domain.[16] Notably, the *Oslo Manual* determines that LOAC rules prevail over the rules of the law of outer space, which are *lex generalis*, when states are parties to armed conflict.[17]

This article will discuss the three commonly accepted LOAC principles of military necessity, distinction, and proportionality. Military necessity refers to taking "measures which are actually necessary to accomplish a legitimate military purpose."[18] Next, the rule of distinction states that civilians and combatants must be distinguishable, and attacks must only be directed against combatants.[19] Finally, the rule of proportionality prohibits an attacker from "launching an attack which may be expected to cause incidental loss of civilian life, damage to civilian objects, or a combination thereof, which would be excessive in relation to the . . . military advantage anticipated."[20] For example, collateral damage may result when attacking dual-use targets. Actors that strike those targets must consider that their destruction "may be disproportionate to the expected military advantage."[21]

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12. Outer Space Treaty.

13. Blount, "Renovating Space," 518.

14. Bryan Frederick and David E. Johnson, *The Continued Evolution of US Law of Armed Conflict Implementation: Implications for the US Military* (Santa Monica, CA: RAND Corporation, 2019), 1.

15. Frederick and Johnson, 2–3.

16. Everett C. Dolman, "Space is a Warfighting Domain," *Æther: A Journal of Strategic Airpower & Spacepower* 1, no. 1 (Spring 2022), https://www.airuniversity.af.edu/.

17. Dinstein and Dahl, *Oslo Manual*, 5.

18. International Committee of the Red Cross (ICRC), "Military Necessity," ICRC (website), n.d., https://casebook.icrc.org/.

19. ICRC, "Rule 1. The Principle of Distinction between Civilians and Combatants," International Humanitarian Law (IHL) Databases, n.d., https://ihl-databases.icrc.org/.

20. ICRC, "Rule 14. Proportionality in Attack," IHL Databases, n.d., https://ihl-databases.icrc.org/.

21. Human Rights Watch (HRW), *Off Target: The Conduct of the War and Civilian Casualties in Iraq* (New York: HRW, 2003), 42.

The US military applies international humanitarian law, now through the *Law of War Manual*, when deciding on rules of engagement, no matter the warfighting domain.[22] The United States expects its Allies, partners, and adversaries to conform to the LOAC as well. The following section will explore three examples of strikes on dual-use structures to later analogize to the space domain.

Operation Allied Force

During the Kosovo War, Serbian leader Slobodan Milošević violated what one legal analyst refers to as "reverse distinction"—the corollary to the principle of distinction that "requires that military personnel and assets be effectively separated from their civilian counterpart to shield potential military targets from destruction."[23] In fact, Milošević "conspicuously recruited thousands of civilians—many of them wearing bull's-eye T-shirts—to assemble on and around potential US bombing aim-points in Belgrade."[24]

This willful placement of civilians—the practice of using human shields—on a legitimate military target is incompatible with treaties and customary international humanitarian law, as well as LOAC. Many of the dual-use facilities consisted of legal military targets such as command-and-control nodes, leadership, lines of communication, and petroleum facilities. They were meant to create Serbian civilian pressure on Milošević's government to terminate the conflict with Kosovo.[25] Despite Milošević's use of human shields, NATO's bombing campaign against civil-military dual-use targets by NATO forces eventually persuaded him to settle with NATO and Kosovar leadership.

For the most part, the United States and its NATO Allies abided by international humanitarian law during Operation Allied Force. The Alliance did not strike many strategic and critical targets because of the concern about distinction and an understanding that hitting civilian infrastructure would erode support for the Allied effort.[26] In fact, target approval took so long that fighter and bomber aircraft destroyed targets faster than new targets could be approved.[27] Brigadier General Randall C. Gelwix, the director of the Combined Air Operations Center leading the air campaign in Operation Allied Force, stated, "We had a playbook of 900 plays, but were only allowed to use 50 of them."[28]

22. DoD, *Department of Defense Law of War Manual* (Washington, DC: DoD, updated December 2016), https://dod.defense.gov/.

23. David A. Koplow, "Reverse Distinction: A US Violation of the Law of Armed Conflict in Space," *Harvard National Security Journal* 13, no. 25 (2022): 51, https://doi.org/; and Goehring, "Capabilities in Space."

24. Koplow, 24.

25. Stephen T. Hosmer, *The Conflict over Kosovo: Why Milosevic Decided to Settle When He Did* (Santa Monica, CA: RAND Corporation, 2001), 66.

26. Headquarters, US Air Force (HAF), *The Air War over Serbia: Aerospace Power in Operation Allied Force* (United States Air Forces in Europe Studies and Analysis Directorate, 2000), 26.

27. HAF, 26.

28. HAF, 26.

The primary reason for the delay thus involved obtaining legal approval of targets, many of which were considered dual-use. Legal and political authorization during the operation required a myriad of considerations: "Is this a legitimate target [under international law]? How does it relate to our military goals? What role does it play in our opponent's system of operations, and how will it affect him if it is destroyed? Can we constrain our intended damage to this target only?"[29] NATO planners were conscientious in planning targets and gaining their approval to create an environment where Milošević would "sue for terms" and bend to NATO's desired humanitarian and geopolitical outcomes.[30]

One strike on a dual-use target, a major bridge in southern Serbia, occurred on May 30, 1999, in Varvarin.[31] In the time between NATO's first and second bomb strikes on the bridge, civilians reportedly gathered to care for the wounded. Initial accounts indicated that after the second round of bombs hit, the number of casualties totaled nine killed and 28 wounded.[32] This attack on the Varvarin Bridge was one of several examples of NATO aircrew destroying targets during the operation that resulted in civilian deaths due to collateral damage, including a missile attack on a bus and a bridge attack where a passenger train was destroyed.[33]

Implications

An analysis of strikes on dual-use targets during Operation Allied Force reveals the geopolitical implications, operational implications, and adherence to international humanitarian law.

Geopolitics. First, the strategic impact of NATO bombings during Phase I of the operation included an adverse reaction from the Yugoslav people, who blamed NATO for turning off their electrical power after NATO airstrikes hit Serbian power facilities. Additionally, NATO's restraint in taking care in choosing targets that adhered to international humanitarian law "may actually have encouraged a resurgence of Serb nationalism and popular defiance."[34] After increased strikes on infrastructure and supply lines in April and May 1999, about 500 civilians were killed by collateral damage, and about 900

29. Andrew Bacevich and Eliot Cohen, *War Over Kosovo: Politics and Strategy in a Global Age* (New York: Columbia University Press, 2002), 7.

30. Bacevich and Cohen, 7.

31. Eric Schmitt, "Allied Air Strikes Kill 9 on Busy Bridge in Serbia," *New York Times*, May 31, 1999, https://archive.nytimes.com/.

32. Schmitt, 6.

33. Philip Shenon, "NATO Admits Missile Hit Bus but Says Bridge Was a Legitimate Target," *New York Times*, May 1, 1999, https://archive.nytimes.com/; and "A Long Litany of NATO Mistakes Hits a New Low," *Irish Times*, May 10, 1999, https://www.irishtimes.com/.

34. Bacevich and Cohen, *War over Kosovo*, 10.

were injured.[35] These civilian casualties increased scrutiny on NATO forces, especially given the intent of Operation Allied Force was "humanitarian intervention."

Operations. Next, and apart from the Varvarin Bridge example referenced above, the operational implications of generally refraining from engaging dual-use targets resulted in a more protracted conflict than the NATO military planners initially desired. The Serbs believed they could continue to work and live normally since they were not being harmed, encouraging Milošević "to believe that he could wait NATO out—that the allied consensus would weaken or that international pressure would force an end to the bombing without obliging him to make any concessions."[36]

LOAC. Finally, NATO forces adhered to international humanitarian law during planning, although tactical decisions may have caused unwanted civilian casualties and collateral damage. American and NATO military planners went to great lengths to ensure the planned targets were consistent with international humanitarian law. While preparing for Operation Allied Force, American and NATO military strategy architects based their plans on three key requirements: "minimize collateral damage, avoid all friendly losses, and preserve the Yugoslav civil infrastructure."[37] These dictations ensured that war planners, operators, and tacticians minimized casualties among the Serb people and collateral damage to targeted areas, adhering to LOAC principles of military necessity, proportionality, and distinction.[38]

Israel and the Associated Press Building in Gaza

On May 15, 2021, the Israeli Defense Forces (IDF) attacked the Al-Jalaa Tower in the Gaza Strip. This building was considered a dual-use facility because it housed legitimate military targets, media offices such as the Associated Press and Al Jazeera, and civilian residences.[39] During this and similar IDF attacks on dual-use buildings, the Israeli forces provide a warning "soft knock" or "knocking on the roof"—in the form of small munitions—before using full kinetic force.[40] These warnings allow civilians and military personnel to leave urban structures targeted by the Israeli Air Force to mitigate collateral damage resulting from kinetic strikes against these large, in-place legitimate military targets.

Although the Israeli Defense Forces limited civilian casualties by providing its standard advance warning, the political and media fallout from the strike in Gaza was enormous because of the number of civilian residences and noncombatant media personnel working

35. Bacevich and Cohen, 22.
36. Bacevich and Cohen, 10.
37. Bacevich and Cohen, 4.
38. HAF, *Air War over Serbia*, 5.
39. Michael Schmitt, "Targeting Dual-use Structures: An Alternative Interpretation," Lieber Institute–West Point, June 28, 2021, https://lieber.westpoint.edu/.
40. Raphael Cohen et al., *From Cast Lead to Protective Edge: Lessons from Israel's Wars in Gaza* (Santa Monica, CA: RAND Corporation, 2017), 45, 67, https://doi.org/.

in the building.[41] In fact, the airstrike provided Hamas and its supporters the opportunity for a "PR terror attack."[42] Even after the IDF released data proving there was a weapon in the basement of the building that could disrupt Israel's Iron Dome missile defense system, the public and Hamas had already won the public affairs campaign to smear Israel and the IDF. In this situation, there was little Israel could do to prevent a negative public relations outcome because of the dual-use nature of the targeted structure.

Implications

Geopolitics. The strategic implications of most Israeli attacks on Palestinian-held territory in the West Bank or Gaza are more significant than most similar strikes by different countries worldwide. This is due to the incredible scrutiny of Israeli strikes on Hamas and Palestinian Islamic Jihad in the urban, densely populated Gaza Strip, and of more limited strikes against these groups in the West Bank.[43] The 2021 attack on the Al-Jalaa building in Gaza was no different. According to Human Rights Watch, although no one was hurt in the building strike, it destroyed many families' homes and businesses.[44] A former IDF general, speaking to one of Israel's most prominent media outlets, stated that the attack on the Al-Jalaa Tower caused "more damage to Israel's image than it provided operational benefit."[45]

Operations. While the strike destroyed Hamas' intelligence assets, the IDF was slow to provide a more detailed explanation of exactly which assets and never provided evidence for its claims.[46] Based on open-source reporting, the IDF "claimed the tower was used by Hamas to set up equipment to block GPS signals to interfere with the military's Iron Dome missile defense system."[47] If the IDF hit the specified target, the airstrike on the Al-Jalaa building could have saved many Israeli lives by ensuring the Iron Dome system adequately protected Israeli citizens from Hamas rocket launches into Israeli territory.

LOAC. In this case, opposing beliefs exist on whether Israel abided by international humanitarian law. Human Rights Watch, the Associated Press, and the Foreign Press Association argue there was insufficient evidence to prove the Al-Jalaa Tower was a

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41. Zachary Keyser, "Israel Slammed for Strike on AP, Al Jazeera Gaza Offices in Attack on Hamas," *Jerusalem Post*, May 16, 2021, https://www.jpost.com/.

42. *Jerusalem Post* Staff, "Gaza AP Building Strike was 'Own-Goal' for Israel – Ex-IDF General," *Jerusalem Post*, October 25, 2021, https://www.jpost.com/.

43. Isabel Kerschner, "Israel Launches Biggest Air Attack on West Bank in Nearly Two Decades," *New York Times*, July 7, 2023, https://www.nytimes.com/.

44. Human Rights Watch (HRW), "Gaza: Israel's May Airstrikes on High-Rises," HRW (website), August 23, 2021, https://www.hrw.org/.

45. Judah Ari Gross, "Former IDF General: Bombing AP Tower in Gaza in May Conflict Was an 'Own Goal,' " *Times of Israel*, October 24, 2021, https://www.timesofisrael.com/.

46. Josef Federman, " 'Shocking and Horrifying': Israel Destroys AP Office in Gaza," Associated Press, May 15, 2021, https://apnews.com/.

47. Gross, "Former IDF General."

legitimate military target; therefore, the Israeli strike was illegal.[48] On the other hand, the Israeli Defense Forces believed they targeted a legitimate military target and did so under international humanitarian law because the Hamas terror group was using the building. They warned building residents in advance—the so-called soft knock—giving them one hour to evacuate before the planned airstrike.[49]

If Israel's allegation regarding Hamas' military use of the building is true, the terror group's employment of building residents as human shields—witting and unwitting—is consistent with previous group tactics, for example, the UN Relief and Works Agency's 2014 discovery of Hamas rockets stored in one of its Gaza Strip schools.[50]

Overall, the negative strategic implications of striking a building that housed Western journalists and Palestinian civilians outweighed the strike's operational utility. The Israeli Defense Forces acknowledged they could have better explained to the public its reasons for targeting the Al-Jalaa building and will create better public affairs plans in the future for similar strikes.[51]

Russian Attacks on Ukrainian Dual-Use Infrastructure

On November 23, 2022, Russian forces executed coordinated missile attacks with cruise missiles and drones on Ukrainian infrastructure, including the state power grid and the water supply.[52] In a single day, these attacks killed at least 12 civilians and injured more than 100 people around the Kyiv region.[53] Also, because of the strikes, at least two Ukrainian nuclear facilities were disconnected from the grid, increasing the electricity deficit in Ukraine. To date, the Russian attacks on Ukraine's infrastructure are ongoing. They have severely disrupted civilian lives and destroyed their property. Last fall in the span of about six weeks (October 10–November 25, 2022), at least 77 civilians were killed in attacks against infrastructure. As of mid-July 2023, at least 9,000 civilians have been killed since the beginning of Russian President Vladimir Putin's aggression against the country.[54]

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48. HRW, "Israel's May Airstrikes"; Federman, " 'Shocking and Horrifying' "; and Keyser, "Strike on AP."
49. Gross, "Former IDF General."
50. Cohen et al., *Cast Lead,* 143.
51. Gross, "Former IDF General."
52. Thaisa Semanova, "Ukraine War Latest: 6 Million Still without Electricity after Russia's Nov. 23 Missile Attack," *Kyiv Independent*, November 26, 2022, https://kyivindependent.com/; and " 'For the Sake of Ukraine's People, Global Community' Russian Federation's Unjustified War Must Stop, Under-Secretary-General Tells Security Council," 9380th Meeting (PM), UN Meetings Coverage and Press Releases, UN (website), July 17, 2023, https://press.un.org/.
53. Office of the High Commissioner of Human Rights (OHCHR), "Ukraine: Attack on Civilians and Infrastructure," UN (website), October 11, 2022, https://www.ohchr.org/.
54. Semanova, "Ukraine War Latest"; and Unjustified War.

Implications

Geopolitics. When considering the overall strategic implications of these strikes, one should understand how they help or hurt Russia's standing in the international community and its geopolitical power. Although operationally Russia has had success with the attacks on potentially legal targets, much of the international community has denounced its actions. NATO Allies and partners continue to condemn Putin's illegal war against a sovereign Ukraine, and Ukraine is now considering seeking membership within the Alliance.[55] Although Russia initially gained territory after striking dual-use infrastructure in Ukraine, the strategic implications for Russia as a global power and influence are negative—the international community is increasingly viewing Russia as a pariah.

Operations. For Russian military forces, attacks on the power infrastructure have been operationally useful because they allowed them to maneuver in the cover of darkness, slowed Ukrainian defenses, and decreased fuel supplies crucial for Ukraine's logistics. These attacks allowed Russian forces not only to create immediate economic hardship and logistical problems for Ukrainian forces but also to apply psychological pressure on civilians who no longer had electrical power at home and work.[56] In the days and months that followed these intense attacks on Ukraine's power systems, Russia gained ground in the east of Ukraine to further its operational military objectives.[57]

LOAC. When considering these attacks within the context of international humanitarian law, legal scholars suggest that some may be unlawful, but many may be legal.[58] The DoD *Law of War Manual* notes "electric power stations are generally recognized to be of sufficient importance to a State's capacity to meet its wartime needs of communication, transport, and industry so as usually to qualify as military objectives during armed conflicts."[59] This is the US military's interpretation of LOAC, but other entities such as Human Rights Watch, the UN High Commissioner for Human Rights, and states including the United Kingdom believe these attacks are unacceptable and in violation of the law of war.[60]

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55. Jim Garamone, "Leaders Agree to Expedite Ukraine's NATO Membership," DoD News, July 11, 2023, https://www.defense.gov/.

56. Andrian Prokip, "Russian Air Attacks on Ukraine's Power System," *Kennan Institute* (blog), October 19, 2022, https://www.wilsoncenter.org/.

57. "Russia Attacks Ukrainian Power Grid and Gains Ground in the East," Al Jazeera, February 10, 2023, https://www.aljazeera.com/.

58. Michael N. Schmitt, "Ukraine Symposium – Attacking Power Infrastructure under International Humanitarian Law," Lieber Institute – West Point, October 20, 2022, https://lieber.westpoint.edu/.

59. DoD, *Law of War Manual*, 219.

60. HRW, "Ukraine: Russian Attacks on Energy Grid Threaten Civilians," HRW, December 6, 2022, https://www.hrw.org/; OHCHR, "Ukraine"; and James Kariuki, "Russia's Systematic Attacks on Ukrainian Civilian Infrastructure Are Unacceptable, and Must End," statement at the UN Security Council on Ukraine, November 23, 2022, https://www.gov.uk/.

Findings

The case studies above analyzed three independent variables related to strikes on dual-use terrestrial targets: geopolitical/strategic implications, operational implications, and adherence to international humanitarian law. Strategically, attacks on dual-use targets during Operation Allied Force, the Israeli-Palestinian conflicts in Gaza, and Russia's war against Ukraine have proven neutral or ineffective for the states' more significant geopolitical goals.

An analysis of the attacks in Serbia by the United States and NATO reveals geopolitical effects were minimal, although human rights organizations condemned the attacks when they resulted in the death or injury of civilians. In the case of the IDF attacks in Gaza, Israel experienced negative public affairs consequences because of the intense scrutiny by human rights organizations and news outlets. In addition, the strategic implications for Russia's actions in Ukraine have been negative, highlighted by the UN's condemnation of its attacks on civilian infrastructure and a lowering of Russia's international political standing.

Unlike the negative or neutral strategic outcomes, operationally, these dual-use target attacks successfully met military and security goals in all three cases; however, when considering adherence to international humanitarian law, these attacks show less clear results. In the cases of the NATO attacks against Serbian targets and in the case of the IDF attack against the Al-Jalaa building in Gaza, the attacker went to adequate lengths to ensure it was advised by military lawyers and minimized civilian casualties. And while there is no evidence Russian military commanders were well advised by their military lawyers, international law experts weighed in on the target selections and believed most aligned with international humanitarian law.

Despite Israel, NATO, and Russia forces executing attacks per the law of armed conflict, human rights organizations and international watchdogs argued there was more these militaries could have done to minimize collateral damage. Still, although the International Criminal Court has recently issued a warrant of arrest for Putin in the context of the war in Ukraine, no attackers have yet been found guilty in an international court for their strikes on the dual-use targets analyzed.[61]

Understanding the geopolitical and operational implications of these terrestrial dual-use target strikes can help to extrapolate the impact of similar strikes in outer space. Moreover, since the Outer Space Treaty extends international law, including the Charter of the United Nations, to outer space, the LOAC implications of terrestrial dual-use strikes may also be applicable to the newest operational domain.

61. International Criminal Court, "Situation in Ukraine: ICC Judges Issue Arrest Warrants against Vladimir Vladimirovich Putin and Maria Alexkseyevna Lvova-Belova," press release, March 17, 2023, https://www.icc-cpi.int/.

Geopolitics

One implication of the increased intermingling of commercial space capabilities and services with military operations and derived effects, particularly when implementing military rules of engagement within LOAC, is the possibility of harming a state's international image. As with Israel's destruction of the Al-Jalaa building, striking or disabling dual-use satellites has the potential to begin a "naming and shaming" campaign against the aggressor. States or organizations like Human Rights Watch may choose to highlight the collateral damage inflicted on civilians by the disabling of these satellites, even if they were legal and valid military targets according to LOAC.

One difficulty with this type of campaign is that the aggressor must be known, which is more difficult to discern in the space warfighting domain than terrestrially. In space, even if one gathers intelligence from various sources, there will likely still be an incomplete picture of who and what was targeted.[62] Also, one of the elements of LOAC, proportionality, must be considered when attacking a target. In the case of space objects, it is challenging to foresee civilian harm that results from kinetic or nonkinetic attacks on dual-use satellites.[63]

Operations

The attacks on dual-use targets analyzed in this article achieved certain operational objectives. In these examples, NATO, Israel, and Russia destroyed important military targets relevant to their overall campaigns. Similarly, in a future conflict, destroying or disabling military space capabilities will be critical to gaining an advantage against an adversary, even if there is a successful naming-and-shaming campaign against the aggressor for its possible damage to civilian infrastructure.

In fact, the potential of the operational success of an attack on a dual-use satellite can be exemplified by Russia's nonkinetic attacks on the Viasat satellite internet network. In the opening days of Russia's war in Ukraine in February 2022, a Russian cyberattack took tens of thousands of Viasat modems offline.[64] Although there is no public data detailing the extent of the damage due to this attack, it is known that the modems had to be sent back to the factory to be replaced.[65] These communications were critical to Ukrainian first responders and military operations and most likely slowed down critical communications between Ukraine's leaders and military personnel during the invasion and into the following weeks.

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62. P. J. Blount, "Targeting in Outer Space: Legal Aspects of Operational Military Actions in Space," *Harvard National Security Journal* (2012), https://papers.ssrn.com/.

63. Abdul Rehman Khan, "Space Wars: Dual-Use Satellites," *Rutgers Journal of Law and Public Policy* 14, no. 314 (Spring 2017): 5.

64. Elizabeth Howell, "Elon Musk Says Russia is Ramping Up Cyberattacks on SpaceX's Starlink Systems in Ukraine," Space.com, October 14, 2022, https://www.space.com/.

65. Howell.

Russia's actions prompted NATO and friendly state entities to reassess their collective sensing capabilities and organize to increase intelligence data-sharing. One example is SpaceX's Starlink network, which provided reliable, high-speed internet to Ukraine after the Russia Viasat attack disabled its military's ground-based internet connections.[66] Using these commercial satellites for Ukrainian military intelligence and communications underscores the importance of commercial satellite capabilities to warfighting. The high-resolution satellite imagery of commercial actors like Maxar and BlackSky and the communications capabilities of Starlink prove that militaries do not need government-specific satellites and capabilities to produce the data and insight necessary to fight and succeed in a conflict.[67]

LOAC

In the terrestrial strikes against dual-use targets in the case studies, NATO and Israel went to great lengths to adhere to the law of armed conflict. Both actors ensured the targets they were striking were legal, and they abided by the principle of distinction by directing the attacks against military operations. In the case of Israel, human rights organizations and the media believed the attack on the Al-Jalaa Tower was unlawful because sources said Hamas had already moved its computers out of the building, altering the legality of the target.[68] Lastly, Russian military forces adhered to LOAC when striking Ukrainian dual-use infrastructure, although human rights organizations continue to argue that those strikes were unlawful because of the large number of civilian casualties. For all three case studies, implications of strikes on dual-use targets included negative media attention and intense scrutiny from international human rights organizations.

Although the law of armed conflict has been well studied, operationally used, and has precedents for use in the traditional warfighting domains, it has yet to be tested in the space domain. Also, since LOAC puts the protection of civilians at the center, and there are very few civilians in space, it is difficult to measure the extent to which civilians are affected by attacks on dual-use satellites. If, however, adversaries launched a massive cyberattack on critical infrastructure satellites, the follow-on effects could be significant:

> Televisions would go blank, mobile networks silent, and the internet would slow and then stop. Dependent on time stamps from GPS satellites, everything from stock markets to bank transactions to traffic lights and railroad switches would freeze. Airline pilots would lose contact with the ground, unsure of their position and without weather data to steer around storms. World leaders couldn't

66. Bec Shrimpton, "Starlink Satellite Support of Ukraine Shows Value of Government–Private Sector Cooperation," Australian Strategic Policy Institute (ASPI)–The Strategist, October 18, 2022, https://www.aspistrategist.org.au/.

67. Marisa Torrieri, "How Satellite Imagery Magnified Ukraine to the World," Via Satellite (website), October 24, 2022, https://interactive.satellitetoday.com/.

68. Adil Ahmad Haque, "The IDF's Unlawful Attack on Al Jalaa Tower," Just Security, May 27, 2021, https://www.justsecurity.org/.

> communicate across continents. In the US military, pilots would lose contact with armed drones over the Middle East. Smart bombs would become dumb. Missiles would sit immobile in their silos. The US could lose early warning of nuclear attacks for parts of Earth.[69]

In this worst-case scenario, there would be great harm to civilians in the terrestrial domains. Yet the second- and third-order effects of losing GPS satellites in a conflict that extends to outer space, for example, will remain largely unknown until these events occur, because analysts have yet to determine the total effects of such a strike.

The conflict in Ukraine also provided insight into Russia's beliefs about the law of armed conflict in outer space. At the UN General Assembly in 2022, the deputy director of the Russian Foreign Ministry's Department for Nonproliferation and Arms Control, Konstantin Vorontsov, stated, "If US satellites were used to aid Kyiv, they could be a legitimate target for a retaliatory strike."[70] This statement legitimizes Russia's attacks on dual-use satellites because, as Vorontsov argues, the satellites can be targeted in accordance with international law.

Recommendations

Based on the findings above, the United States, NATO, and other space powers must understand the strategic and operational consequences of strikes on dual-use satellites. If the target is legal in accordance with international humanitarian law, the geopolitical effects of these dual-use attacks would likely be minimal, but the potential collateral damage is still largely unknown. Also, although attacks on dual-use satellites might help near-term operational military goals, longer-term effects on the military operation may be both positive and negative. Additionally, responses to such attacks—as in the case of Starlink in Ukraine—may serve to increase the defender's resilience, nullifying those initial operational gains.

Considering geopolitical, operational, and LOAC outcomes from terrestrial attacks against dual-use targets and the certain increase in similar attacks against dual-use satellites as they proliferate and become more attractive military targets, states should consider more research on when it is appropriate to attribute an actor for disabling or destroying dual-use satellites that could cause harm to civilians or cause collateral damage. The most significant difficulty in enacting a naming and shaming campaign is attribution. As with the cyber domain, it may be challenging to know which actor is causing harm to assets

69. Jim Sciutto, "US Military Prepares for the Next Frontier: Space War," CNN Politics, November 29, 2016, https://www.cnn.com/.

70. Ann M. Simmons and Micah Maidenberg, "Russia Says It Could Target US Commercial Satellites in Ukraine War," *Wall Street Journal*, October 27, 2022, https://www.wsj.com/.

in the space domain due to the physical distance from orbit and techniques that hide the attacker.[71]

Second, the Department of Defense should begin to measure the potential effects on civilian infrastructure when it chooses to intermingle military and commercial capabilities of satellites. Secretary of the Air Force Frank Kendall's first operational imperative involves greatly increasing the number of satellites in the US Space Force architecture, which may include adding military capabilities to commercial satellites.[72] Because of this desired capability, the United States and its Allies must understand the potential collateral damage should an aggressor decide to extend a conflict into outer space and attack a dual-use satellite to gain operational advantage.

Finally, striking satellites in orbit does not only affect military capabilities or allow for terrestrial collateral damage. If they are kinetic, these attacks will also increase the amount of debris in orbits affecting the growing number of civil, military, and commercial assets in space. One only has to reflect on the November 2021 Russian antisatellite test to understand how one kinetic strike can interfere with and potentially degrade peaceful international efforts in space such as the International Space Station or cause satellites in orbit to use more fuel to maneuver away from the destructive debris.[73]

Nations capable of creating this debris must also consider the second- and third-order effects of potentially causing orbits to be completely unusable for future satellite capabilities and how losing those capabilities will affect modern life on Earth.

Additionally, Russia and the United States have declared that the "destruction of a satellite should be considered an 'act of war.'"[74] Using kinetic or nonkinetic weapons to destroy a satellite is likely to begin a conflict, increase orbital debris, and change the character of war. World leaders must seriously consider these ramifications before approving attacks on outer space assets.

Several other implications not studied in this article that should be explored in future research are the need for indemnification of commercial companies' assets used for national security, the state's protection and defense of commercial companies' dual-use satellites, strategic implications of intermingling commercial and nuclear command and control satellites, and the regulation of companies that provide military services on commercial assets by governing organizations. International humanitarian law experts should

71. Office of the Director of National Intelligence (ODNI), *Annual Threat Assessment of the U.S. Intelligence Community* (Washington, DC: ODNI, February 6, 2023), 8, 16, https://www.dni.gov/; and Niall Firth, "How to Fight a War in Space (and Get Away with It)," *MIT Technology Review* 122, no. 4 (July/August 2019), https://www.technologyreview.com/.

72. Charles Pope, "Kendall Highlights Space's Importance, Need to 'Transform' Operations and Thinking for the Domain," US Space Force (website), April 5, 2022, https://www.spaceforce.mil/.

73. Shannon Bugos, "Russian ASAT Test Creates Massive Debris," Arms Control Association, December 2021, https://www.armscontrol.org/.

74. Tim Martin, "Space Force Should Offer European Allies Protection from Anti-Satellite Attacks: Saltzman," Breaking Defense, July 17, 2023, https://breakingdefense.com/.

also continue exploring the threshold for using force in outer space, particularly since most known attacks are nonkinetic and include cyber, directed energy, and electronic warfare.

The growing militarization and weaponization of space, along with a critical reliance on dual-use satellites, necessitates a careful consideration of lessons learned from terrestrial strikes against analogous dual-use targets. Military and political decisionmakers must consider the implications for geopolitics, operations, and international humanitarian law before considering kinetic or nonkinetic attacks on targets in outer space. The key outcomes and effects from those terrestrial operations will help when planning for and conducting operations against similar objectives in space and will ensure states are adhering to international law.

AI Readiness in a US Air Force Squadron

Alexander E. Farrow
Victor Lopez

Prioritizing artificial intelligence readiness in the US Air Force is vital. To confront this challenge, squadron commanders must spark (1) data-centric innovation and (2) artificial intelligence ideation at the warfighter level. Fusing Department of Defense policy with current management theory on digital transformation and strategy, this article explores crafting a data strategy, managing data infrastructure, cultivating technical talent, and redesigning organizational processes, all in support of fostering innovative culture at the squadron level. This unique action plan allows leaders to catalyze data-centric innovation into the artificial intelligence ideation process, posturing squadrons and parallel organizations in other services for digital warfare.

The proliferation of artificial intelligence (AI) technologies is leading to a rapid boost in productivity akin to a new industrial revolution.[1] Historically, as industries are transformed, jobs are replaced or added, and supply chains are rearranged, three main challenges emerge: domestic political stress, changing means of production, and potential technological singularity.[2] These stresses threaten the global world order by injecting inequality and insecurity into the international system.[3] As the proliferation of AI threatens to disrupt global stability, the United States has a key role to play in assuaging rising tensions. Google's generative AI chatbot Bard states,

> Nations should prioritize AI development because it has the potential to revolutionize many aspects of our lives, including the economy, healthcare, education, and national security. AI can be used to automate tasks, improve efficiency, and make better decisions. It can also be used to create new products and services, and to improve existing ones.[4]

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1. Nicholas D. Wright, "Artificial Intelligence's Three Bundles of Challenges for the Global Order," in *Artificial Intelligence, China, Russia, and the Global Order: Technological, Political, Global, and Creative Perspectives*, ed. Nicholas D. Wright (Maxwell AFB, AL: Air University Press, 2019), 17, https://www.airuniversity.af.edu/.
2. Wright.
3. Wright, 17.
4. Bard, response to "Why should nations prioritize AI development?," March 30, 2023, Google Bard, https://bard.google.com/.

America's peer and near-peer competitors are vying for AI research, development, and integration with respect to national security. For example, President Xi Jinping has stated the importance of "intelligentization" for China's national security objectives.[5] The People's Liberation Army has transcribed this goal into four possible AI use cases, including unmanned weapons, information processing, decision-making, and cognitive warfare. [6] Russia has also expressed a willingness to organize its defense sector for AI militarization, as evidenced by efforts from its Advanced Research Foundation (akin to the Defense Advanced Research Projects Agency).[7] The Ministry of Defence has even begun developing a defense innovation "technopolis" on the coast of the Black Sea, where it hopes to host an AI lab. [8]

Readying the US Air Force

In the US Air Force, AI readiness is crucial for tomorrow's digital war. Notably, the 2019 *United States Air Force Artificial Intelligence Annex* challenges all Airmen to understand and employ AI as a lever to increase productivity across the force.[9] In fact, a former chief of staff of the Air Force (CSAF) and former secretary of the Air Force emphasized the potential for this technology to fundamentally change the future, noting "everyone is responsible to purposefully consider and attempt to include AI in everything we do" and "[e]xploration, prototyping, and collaboration are not only encouraged, but critical to our future."[10] The annex provides a call to action, which perfectly encapsulates CSAF General Charles Q. Brown Jr.'s priority to accelerate change.[11] In sum, the Air Force's prioritization of AI as a critical technology indicates its fundamental relevance to increasing productivity across the defense industry.

To enable the Air Force's warfighters, guidance from senior leadership is essential for the establishment of a data backbone. But the Department of Defense has struggled to have lower-level units adopt enterprise-wide databases for mission-critical data that would enable higher-level model predictions. One reason is that the Defense Department does not yet have standardized automation or structured data analytics.[12] Until the

5. Koichiro Takagi, "Xi Jinping's Vision for Artificial Intelligence in the PLA," *Diplomat*, November 16, 2022, https://thediplomat.com/.

6. Takagi.

7. Samuel Bendett, "The Rise of Russia's Hi-Tech Military," American Foreign Policy Council (AFPC), June 26, 2019, https://www.afpc.org/.

8. Bendett.

9. David Goldfein and Matthew Donovan, *2019: The United States Air Force Artificial Intelligence Annex to the Department of Defense Intelligence Strategy* (Washington, DC: Department of the Air Force, 2019), https://www.af.mil/.

10. Goldfein and Donovan, 6.

11. Charles Q. Brown Jr., *Accelerate Change or Lose* (Washington, DC: Chief of Staff of the Air Force, August 2020), https://www.af.mil/.

12. Nick Harrison and Deborah O'Neill, "If Your Company Isn't Good at Analytics, It's Not Ready for AI," *Harvard Business Review*, June 7, 2017, https://hbr.org/.

data conditions for artificial intelligence/machine learning (AI/ML) are widespread, digital transformation should take the form of narrow use cases at grassroots levels.[13]

In the Air Force, the squadron is the appropriately tiered organization to pioneer this grassroots data-centric innovation. As former CSAF General David Goldfein stated,

> Our service culture and traditions manifest themselves in the squadron because our Airmen most readily identify with this core fighting unit. Squadrons are the engines of innovation and esprit de corps. Squadrons possess the greatest potential for operational agility.[14]

This examination and the recommendations focus on the squadron as the primary unit of analysis; recommendations are therefore aimed at squadron commanders. Applied to other US service echelons, these recommendations are appropriate for Army and Marine Corps battalions and Navy and Marine Corps squadrons. Squadron commanders must cultivate AI readiness by encouraging data-centric innovation and AI ideation at the warfighter level.

Background

While the recommendations apply military-wide, certain definitions and challenges unique to the Air Force context underpin this analysis.

Definitions

Artificial intelligence "refers to the ability of machines to perform tasks that normally require human intelligence."[15] This definition is employed widely and often without deep thought about critical considerations such as data, data pipelines, models, and human-centered design. Two broad distinctions in AI are of note: automation and prediction.[16] Automation is an expert system that accomplishes predictable tasks given a set of inputs. Automation is analogous to a standard Microsoft Excel spreadsheet which executes the same user-defined mathematical function given a set of inputs. Prediction forecasts an outcome based on data.

When considering the aspect of prediction, it is important to note the growth of machine learning. Instead of explicitly programming a mathematical function, ML enables the computer to write its own function to give a prediction; this prediction, in concert with a large corpus of data, is at the heart of modern machine-learning applications. This

13. John Anderson, Marc Losito, and Sean Batir, "The Commander's AI Smartcard: Artificial Intelligence Is Commanders' Business," Small Wars Journal, February 8, 2021, https://smallwarsjournal.com/.

14. David Goldfein, *CSAF Focus Area: The Beating Heart of the Air Force… Squadrons!* (Washington, DC: CSAF, August 2016), 1, https://www.af.mil/.

15. Goldfein and Donovan, *Artificial Intelligence Annex*, 3.

16. Greg Allen, *Understanding AI Technology* (Washington, DC: Joint Artificial Intelligence Center, 2020), https://www.ai.mil/.

prediction is analogous to the line of best fit in algebra, extrapolated to an unknown data point. Forms of ML include supervised learning, unsupervised learning, and reinforcement learning.[17]

Unique Challenges

Organizations generally encounter friction associated with digital transformation. Some specific challenges prevalent in the Air Force include information withholding, over-standardization, technical debt, and acquisition limitations.

Withholding information. Comprehensive data-centric transformation is contingent upon the entire defense workforce shifting its cultural disposition from "information withholding" to "information sharing."[18] Classification barriers, airframe-specific proprietary information, differing IT systems, and competition among units are all potential sources of friction in comprehensive data-centric transformation across the Air Force enterprise. Leaders should be mindful of these potential organizational barriers that may stifle information sharing and cross-organizational collaboration.

Over-standardization. In an operational military unit, practices are often standardized to enforce predictability and mitigate risk. Yet too much standardization can stifle out-of-the-box thinking, limiting the development of new techniques. In one study of a university flight school, researchers found that excessive standardization could result in a culture that stagnated innovation.[19] This, in turn, might limit students' exposure to technological advancements in aviation. Conversely, too little standardization might coincide with too much unfocused innovation, resulting in degraded discipline and professionalism. Air Force leaders must carefully weigh standardization and innovation when seeking to empower experimentation at the warfighter level.

Technical debt. Technical debt in an organization's IT infrastructure may slow adaptability. Technical debt, resulting from an agglomeration of inefficient software shortcuts to systems over time, can degrade comprehensive IT infrastructure.[20] While accumulating this debt might be an acceptable trade-off when pursuing rapid software development, stacking debt might also cripple systems with inefficiency, resulting in tangible costs.

In one example from civil aviation, Southwest Airlines' "antiquated" technology, complicated with manual processing and "spotty" technical improvements, resulted in an

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17. Allen, 4.

18. Department of Defense (DoD), *DoD Data Strategy* (Washington, DC: DoD, September 30, 2020), 4, https://media.defense.gov/.

19. Michael Wetmore, Chien-tsung Lu, and Philip Bos, "Modeling the Balance between Standardization and Innovation in a Flight School," *Journal of Aviation/Aerospace Education and Research* 17, no. 3 (2008), https://doi.org/.

20. Philippe Kruchten, Robert Nord, and Ipek Ozkaya, *Managing Technical Debt: Reducing Friction in Software Development*, 1st ed. (Boston, MA: Addison-Wesley Professional, 2019).

operational IT meltdown in December 2022.[21] In this case, the interwoven yet outdated infrastructure caused cascading problems that disrupted operations. The Air Force also maintains archaic IT infrastructure that may pose problems when leaders seek to streamline digital transformation efforts. As an example, a former director of operations at the Department of the Air Force-Massachusetts Institute of Technology (MIT) Artificial Intelligence Accelerator expressed such frustration about his experience with computer lag that he penned a "fix our computers" call to action, prompting a joint response by several DoD chief information officers.[22]

Acquisition Limitations. The hype around AI will naturally inspire defense contractor solutions to data-centric challenges. Yet relying solely on contractor technical talent is imprudent, as the acquisition timelines are unacceptably uncompetitive in relation to those of near-peer competitors such as China.[23] Intellectual property law also prevents the transformation of a narrow-use case product into an enterprise-wide, scaled product. Consequently, contractor solutions can be narrow, stale, and expensive. Furthermore, warfighters, not contractors, are typically the end users of tools that weaponize data. Air Force leaders must weigh the inefficiency in contracting solutions and consequently inspire organic talent within their organizations. In other words, uniformed warfighters typically assume a significant role in readying the force for artificial intelligence.

Data-Centric Innovation

Artificial intelligence technologies are capable of increasing productivity and effectiveness at the operational Air Force level across a range of use cases from COVID-19 resource allocation to general staffing assignments to drone imagery analysis.[24] Yet the key to AI integration is data; data, a strategic asset, readies the digital landscape for artificial intelligence and machine learning. [25] From enhanced intelligence to all-domain targeting to integrated command and control, operationalized data will undoubtedly underpin future warfare.

For operational data across the Air Force, squadron commanders must engender data-centric innovation at the unit level. Inspiring innovation will lead to Airmen entrepreneurially finding opportunities to streamline data practices and architecture. After all, it is the frontline warfighter who often first realizes the effects of inefficient data use. With a data-centric mindset, warfighters may subsequently integrate AI technology. To inspire

21. Gregory Wallace, "Insiders at Southwest Reveal How the Airline's Service Imploded," CNN, December 30, 2022, https://www.cnn.com/.

22. Lee Ferran, "Military CIOs Say They Take 'Fix Our Computers' Rant 'to Heart,' " Breaking Defense, February 4, 2022, https://breakingdefense.com/.

23. Eric Lofgren, "China's Weapons Acquisition Cycle 5–6X Faster than the United States—'We Are Going to Lose' If We Don't Change," *Acquisition Talk* [blog], July 2, 2022, https://acquisitiontalk.com/.

24. Brandi Vincent, "Air and Space Forces Lean into Data-Informed Decision-Making," DefenseScoop, March 22, 2023, https://defensescoop.com/.

25. DoD, *Data Strategy*, 1–3; and Allen, *Understanding AI Technology*, 3.

data-centric innovation, a commander should craft a data strategy, adopt infrastructure, cultivate talent, redesign the organization, and shape innovative culture.[26]

Data-Centric Innovation

Crafting a Data Strategy

The *DoD Data Strategy* provides a template for transforming the Department into a data-centric organization.[27] This overarching strategy articulates key priorities, including its eight guiding principles, four essential capabilities, and seven goals and associated enabling objectives.[28] Commanders can weave this guidance together with their organization's headline mission statement to craft a data strategy. A nuanced data strategy is necessary for data-centric mission success because it outlines clear pathways for frontline service members to understand how to think about the role of data in everyday operations.

By crafting a data strategy, a commander establishes a beacon around which the squadron can mobilize. A comprehensive strategy has certain critical components: a measurable objective, defined scope, and articulated advantage.[29] It is a reflection of the value proposition and brand positioning of that organization. For example, IKEA's value proposition sets itself apart from other furniture stores in that it articulates to customers what to expect and what not to expect: IKEA is a discount furniture store with a modern look and an exciting maze of showrooms. Customers can expect that IKEA furniture will not be assembled or delivered.[30] The retailer's mission statement commits "to offer a wide range of well-designed, functional home furnishing products at prices so low that as many people as possible will be able to afford them."[31]

An effective strategy should consider resources for and limitations of operationalizing data in tandem with the squadron's primary mission. Importantly, most squadrons will find resources—such as funding, technical talent, and data infrastructure—are scarce.[32] Moreover, operational bandwidth might also be limited, especially in a busy squadron. Yet a commander can carefully engender innovation by holding the unit accountable for

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26. Charles A. O'Reilly and Michael L. Tushman, *Winning through Innovation: A Practical Guide to Leading Organizational Change and Renewal*, rev. ed. (Boston, MA: Harvard Business School Press, 2002).

27. DoD, *Data Strategy*.

28. DoD, 3–9.

29. David J. Collis and Michael G. Rukstad, "Can You Say What Your Strategy Is?," *Harvard Business Review*, April 2008, 4, https://hbr.org/.

30. Alessandro Di Fiori, "The Art of Crafting a 15-Word Strategy Statement," *Harvard Business Review*, February 12, 2014, https://hbr.org/.

31. "The IKEA Vision and Values," IKEA (website), accessed July 10, 2023, https://www.ikea.com/.

32. John A. Ausink et al., *Improving the Effectiveness of Air Force Squadron Commanders: Assessing Squadron Commander Responsibilities, Preparation, and Resources* (Santa Monica, CA: RAND Corporation, 2018), 34, https://doi.org/.

marginally more than it can control with given resources.[33] In this gap lies the incentive for entrepreneurialism.

A data strategy should revolve around the inevitable integration of data and predictive technology like AI. Through this lens, it could be useful to consider a fundamental machine learning formula: data + algorithm + training compute = prediction.[34] Fine-tuned prediction, in turn, might hone process efficiency and effectiveness. This strategy should integrate these concepts into the unit's competitive positioning. In crafting the strategy, a commander must also consider where data currently exists in the organization as well as methods of automating data collection and curation. Lastly, a cohesive data strategy should tie these curation efforts to higher headquarters' strategy, efforts, and guidance so that the organization is well poised to meet the squadron and senior leadership priorities.

The idea of a data strategy is fairly novel; however, a few case studies illustrate how leadership might think about the implications of data strategy. In 2018 and 2019, Procter & Gamble crafted a data strategy as a part of its data-centric digital transformation.[35] Initially, the data strategy articulated baseline policies upon which smaller units could tailor their frontline execution. Yet the company faced some unique tensions regarding data governance—namely, the leadership team debated how restrictive these policies should be. If the policies were overly restrictive, leadership could retain standardized control over execution; if the guidelines were looser, frontline employees could tailor policies directly with execution priorities. Inevitably, where leaders fall along this continuum sends a signal to the organization and should be aligned with how much agency leadership wishes to cede to operators.

In the Air Force context, such policies regarding control are, effectively, mission command. The consideration regarding operator agency is a decision about balancing centralized command, distributed control, and decentralized execution.[36]

Like Procter & Gamble, the Air Force Installation and Mission Support Center (AFIMSC) also operationalized data strategy. The 2021 AFIMSC strategy supports "DoD and Air Force data efforts, establishes AFIMSC data governance structure, advocates for AFIMSC data sharing, supports data-aware organizations, and provides Airmen tactical advantage through data."[37] This strategy underpinned the organization's success in being one of the first to use the VAULT (visible, accessible, understandable, linked, and trusted) data platform, a unique data visualization tool. Through this tool, AFIMSC

33. Robert Simons, "Designing High-Performance Jobs," *Harvard Business Review*, July–August 2005, https://hbr.org/.

34. Neil D. Lawrence, "Data Readiness Levels," arXiv, May 5, 2017, 1, https://arxiv.org/.

35. Srikant M. Datar, Sarah Mehta, and Paul Hamilton, "Applying Data Science and Analytics at P&G," Harvard Business School Case 121-006, July 7, 2020, 4–5.

36. Headquarters, US Air Force, *The Air Force*, Air Force Doctrine Publication 1 (Maxwell AFB, AL: Curtis E. LeMay Center for Doctrine Development and Education, March 1, 2021), https://www.doctrine.af.mil/.

37. Malcolm McClendon, "AFIMSC Accelerates Change across the Enterprise with Big Data," Air Force Installation & Mission Support Center, July 17, 2021, https://www.afimsc.af.mil/.

harnesses data and shares it with commanders to provide greater perspective on installation health, effectively eradicating months of work.

Adopting Infrastructure

Curated, organized, and labeled data, as well as flowing data pipelines, are infrastructure upon which technical talent will inevitably innovate. An action team consisting of the commander, director or assistant director of operations, security officer, tactics officer, and intelligence specialist would be well poised to identify and assess the squadron's data infrastructure. This team can outline the initial sources of data, identify respective data readiness levels, and maintain data pipelines.[38] As a starting point, one possible source of data might be the key performance metrics that a commander requests of their staff for weekly, monthly, or quarterly reports. These metrics and their derived data sources are likely what can be collected for automated reports. Later, these same databases could be used for predictive analytics.

The team should identify actionable first steps toward bolstering and sharing data pipelines with all relevant Airmen and organizations. For additional guidance, the Department of the Air Force chief data and AI officer has outlined various data platforms which can be adopted with the proper security controls in mind. Finally, there might be other units, combatant commands, major commands, or higher headquarters that use these same processes and data foundations. Squadron data are important elements of higher headquarters' decisions; consequently, commanders should ensure the proper flow of data up the chain of command. Finally, the responsibilities of this action team and management of squadron data infrastructure may eventually shift to the chief technology officer (CTO, described below).

As an example of how strategy informs data infrastructure, Procter & Gamble debated data management extensively.[39] For information that could be widely used by the entire organization, the leadership team saw a clear use for centralizing it in a consolidated data repository—a data lake.[40] Effectively, this allowed multiple divisions to draw upon the same information for analysis and operations. Yet the organization also created smaller data hubs that pooled centralized data and added regional flavor. [41] The key tension with this model was the question of how much standardization to apply to the smaller data hubs. In the Air Force context, this sort of a centralized/decentralized hybrid model might best maximize data-sharing and unit-level security implications.

In the Air Force, there are two tools that might help squadron data teams streamline data efforts. The VAULT Platform gives teams the ability to upload, manage, and share

38. Lawrence, "Data Readiness Levels."
39. Datar, Mehta, and Hamilton, "Data Science," 4–5.
40. Google Cloud, "What Is a Data Lake?," Google Cloud, accessed July 10, 2023, https://cloud.google.com/.
41. Datar, Mehta, and Hamilton, "Data Science," 5–6.

data.[42] From this platform, data teams can build machine learning algorithms and display data in an unprecedented way, enhancing productivity across the enterprise. Additionally, the Air Force Research Lab's redForce AI is a DevOps platform that supports AI project development, including in the data preparation phase.[43]

Cultivating Talent

Managing technical talent is perhaps the greatest challenge that any data-centric organization faces. For context, corporate technology companies as well as world-class defense innovation units, like Kessel Run, struggle with this.[44] One Air Force unit experimented with unique organizational changes to cultivate and augment its technical workforce: the Department of the Air Force MIT Artificial Intelligence Accelerator.[45]

Tasked to solve some of the most technical problems in the Air Force, this small unit needed the best talent available. First, it leveraged its partnership with the university to network with civilian researchers, professors, and experts. Additionally, it established temporary fellowships to locate, upskill, and employ Air Force talent from other organizations. The unit also created open-access challenges with scrubbed, public datasets in the hopes of piquing the interest of civilian software engineers. The Accelerator case highlights some innovative ways in which a military unit can cultivate talent through unique organizational design principles.

Additionally, one valuable Air Force resource is often overlooked. Digital University, a joint venture of the US Air Force and US Space Force, is a free education platform for Airmen and Guardians, and courses span a wide variety of technical material.[46] By promoting Digital University, commanders can motivate curious Airmen to build data literacy through focused coursework. The squadron commander might encourage flight leadership to authorize each Airman several work hours per week for education. Such incentives can be institutionalized; for example, learning-path completion might be included in officer and enlisted performance reports.

Finally, executive courses on AI and ML could offer squadron and flight leadership an opportunity to learn how data tools can increase workplace productivity. In this way, leaders can identify and guide use cases in a more informed way.

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42. Secretary of the Air Force Public Affairs, "Chief Data Office Announces Capabilities for the Vault Data Platform," US Air Force (website), October 11, 2019, https://www.af.mil/.

43. "Modernized Acquisition of AI Capabilities from Need to Operations in Months," redForce, Air Force Research Laboratory, accessed March 31, 2023, https://redforceai.us/.

44. Anthony Goldbloom and Craig Wiley, "Hiring Exceptional ML Talent: Top Qualities We Look for at Google," *Forbes*, March 15, 2021, https://www.forbes.com/; and Damany Coleman, "Kessel Run Hosts Software Working Group," KesselRun, August 4, 2022, https://kesselrun.af.mil/.

45. See Maria P. Roche and Alexander Farrow, "Accelerating AI Adoption in the US Air Force," Harvard Business School Case 723-429, March 2023.

46. "Empowering Tomorrow's Warfighter," Digital University (website), accessed March 31, 2023, https://digitalu.af.mil/.

Redesigning the Organization

Positioning technical talent within the organization is critical. The initial inclination might be to place talent in the tactics shop. Relatedly, a commander might create a separate data shop that works closely with IT or security. The advantages of these approaches are that homogenous teams might enhance group learning and ideating, potentially resulting in ideas originating in one central office.[47] Yet concentrating talent elicits groupthink, subgroup factions, and consequently, poor information-sharing across the organization.

In fact, this was the exact issue that the Procter & Gamble leadership team contemplated as they sought to prioritize data-centric analytics in 2018 and 2019.[48] At first, leadership embedded the data scientists within operational teams. Yet they quickly realized that managers viewed data scientists as outsiders to the frontline team; consequently, managers sometimes dismissed their key ideas. By failing to understand the full scope of the data scientists' skills, managers often did not employ them effectively to the mission.

To preempt data scientists' frustration and decreased morale, company leadership established a centralized technical talent staffing model, fostering community and standardized collaboration. Of course, pooling talent outside of the business units risked losing some adaptability at the operational level. Effectively, designing technical talent placements is a balance and carries tradeoffs.

In the Air Force context, one approach is to designate—as an additional duty—a data architect in each flight or shop. First, this promotes greater information diversity in the flights, which translates to more holistic problem-solving.[49] Second, embedded data architects can source opportunities to implement data-driven innovation in a more decentralized, organic manner. Use cases will address a vast variety of problems across the organization.

Furthermore, all data architects should report to a chief technology officer who is integrated directly with squadron leadership. An appropriate placement for this officer is at the assistant director of operations level, where they can work closely with injecting technical perspective into operational discussions. Formalizing this role legitimizes its integral importance at the leadership level. The CTO should also assume responsibility for continuously managing the overall data flows across the squadron's lines of effort, aiming to assess and upgrade data readiness levels wherever possible.

Lastly, the squadron must track technical talent as a component of career development. This element is important because it allows leadership to intentionally assign an experienced data architect to a squadron shop or other unit that will best capitalize on their

47. Cristina Gibson and Freek Vermeulen, "A Healthy Divide: Subgroups as a Stimulus for Team Learning Behavior," *Administrative Science Quarterly* 48, no. 2 (2003), https://doi.org/.

48. Datar, Mehta, and Hamilton, "Data Science," 6–7.

49. Karen A. Jehn, Gregory B. Northcraft, and Margaret A. Neale, "Why Differences Make a Difference: A Field Study of Diversity, Conflict, and Performance in Workgroups," *Administrative Science Quarterly* 44, no. 4 (1999), https://doi.org/.

unique education and experience. In a flying squadron, flight qualifications differentiate experience levels—that is, experienced pilot, instructor, and evaluator. A commander can institutionalize a similar tracking mechanism for technical talent with special experience identifiers (SEIs). The training shop can institutionalize standards for awarding an SEI, propose the new SEI to the Air Force enlisted/officer classification directory, and ensure each data architect's official records reflect this upgrade.

Shaping Culture

Building a culture of sustained innovation can be difficult because innovation is experimentation, which does not always translate to measurable key performance indicators or in annual reports. Yet, to press the boundaries of innovation, an organization must empower employees to experiment, even if only one of multiple theoretical projects proves successful. In other words, the organization must allow for experimentation risk.

Moog, an engineering company with a history of defense contracts, maintains a culture of supportive experimentation.[50] Through a flat hierarchy and culture of collaborative togetherness, the company fosters empowerment. In one instance, when a client demanded that an employee be fired for a mistake, the chief executive officer quickly dismissed this demand and defended the employee.[51] It was common for the chief executive officer to directly call a junior employee and source their opinion.[52] Additionally, internal awards like the HR Hero Award gave peers a chance to nominate and highlight exceptional performance.[53] Effectively, these practices lessen the risk of experimentation failure, empower employees to take risks, and affirm the organization's commitment to innovation.

In the Air Force, rigid hierarchy, annual budgets, and performance reports work against an experimental culture. Yet a squadron commander can encourage innovative practices at the operational level. Squadron and flight commanders should cultivate an environment in which Airmen feel empowered to innovate because leadership assumes innovators operate with productive, responsible intent. For example, this might manifest in a scenario in which a senior MQ-9 pilot accepts more mission risk when a junior aircrew member experiments with a new process for piping mission data. In this case, yielding some procedural rigidity to promising experimentation conveys a message of leadership flexibility.

In addition, by publicly rewarding data-centric innovations, squadron and flight leadership will highlight talent, signal support, and incentivize subsequent experimentation. One costless mechanism for doing this might be to establish new squadron monthly and quarterly awards, such as a top innovator or top data disrupter.

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50. Brian J. Hall et al., "Innovation at Moog Inc.," Harvard Business School Case 922-040, March 2022 (revised January 2023).
51. Hall et al., 4.
52. Hall et al., 5.
53. Hall et al., 4–6.

AI Ideation

After the squadron's data-centric innovation ecosystem is primed, AI needs to be integrated to increase productivity. In this phase, leadership can task supervisors throughout the unit to embark upon an AI ideation process. The goal of this process is to discover ways to improve processes through an AI lens, as well as methods for how to acquire data-driven solutions. The following framework serves as guidance for how to craft an action plan for the AI ideation process.[54]

Phase 1: Diagnosis

The first step of a thorough ideation action plan is a comprehensive diagnosis of the problem. This diagnosis begins by broadly outlining a problem that might be remedied by the application of AI. Next, analyzing the problem involves identifying foundational causes. One technique for uncovering root causes of technical problems, called the 5 Whys, is employed by the Toyota Production System; the technique essentially involves asking why five times, which typically results in the diagnoses of the causes.[55]

Each root cause has several key considerations, including organizational context, stakeholder concerns, leadership guidance, and legal constraints. Identifying the considerations for each root cause may help illuminate some common roadblocks across different problem areas. Conducting research into potential public and commercial solutions will help leaders understand how to address any root causes. Gathering this perspective will help determine when to innovate, when to acquire, and when to employ a combination of both.

During ideation, limited resources should not constrain action planning. Instead, leadership could adopt the following forward-leaning definition of entrepreneurial management: "the pursuit of opportunity without regard to resources currently controlled."[56] Also, a good diagnosis identifies competitive advantages. Perhaps the squadron has an information advantage because it is the inevitable end-user of the solution.[57] Maybe certain squadron leaders retain expertise, network, and authority that might help pool key resources together. This step will help identify why the squadron is best positioned to undertake this project.

Weaknesses also need to be identified. What perspective, skills, talent, or assets are missing that will be critical to the success of the project? Importantly, AI fixes cannot be ascribed to all workplace problems. For example, a developer might identify a way to use a ML model to sort an email inbox by priority. If this user's primary goal is to lessen the

54. Tsedal Neeley, "Six Simple Steps to Action Planning," Harvard Business School Background Note 421-033 (August 2020).

55. Eric Ries, "The Five Whys for Start-Ups," *Harvard Business Review*, April 30, 2010, https://hbr.org/.

56. Tom Eisenmann, "Entrepreneurship: A Working Definition," *Harvard Business Review*, January 10, 2013, https://hbr.org/.

57. Scott Shane, "Prior Knowledge and the Discovery of Entrepreneurial Opportunities," *Organization Science* 11, no. 4 (July–August 2000), https://doi.org/.

volume of emails they are receiving, perhaps they might assess that they need to delegate more tasks to subordinates rather than rely on a potentially imperfect ML model.

Phase 2: Goals

The overall objective of a project needs to be defined. This process involves hypothesizing specifically which type of AI might help best achieve an objective: automation or machine-learning predictions. Some additional important considerations that will frame the scope of this goal might include command guidance, classification considerations, or legal constraints. The goal should be appropriately narrow.[58] It is not feasible, for example, to set the goal of fixing an enterprise-wide problem when the problem resides at the squadron level. Conversely, an overly narrow solution might already exist commercially.

Phase 3: Actionable Steps

Outlining actionable steps to operationalize an idea will help structure the workflow. Although there is room for creativity in how to craft each step, some important AI-specific considerations are as follows:

Data engineering will likely encompass most of the effort, as AI relies on sustainable, training-quality data. A machine-learning model will require consistent training, validation, and testing data throughout its lifecycle. Broadly, this involves evaluating the readiness of the available data to minimize the incidence of collection unreliability, mislabeling, missing values, privacy, and proprietary concerns.[59]

A reliable data pipeline should continuously feed new data to machine-learning engineers to ensure sustainability. This data pipeline should rest on automated and standardized data processes to minimize the cost and time of maintaining the flow.[60]

A plan to operationalize the squadron's assets to build an appropriate model might include considerations of inherent expertise and resources. The unit will benefit when a leader recruits, acquires, or develops the means to choose the best algorithm to train, test, and deploy the best model. The best model might not always be the most complicated one; a logistic regression may be able to achieve the objective better than a deep neural network. In other words, if the equation to predict a specific outcome is as simple as $y = mx + b$, it may not be necessary to develop more complicated models.

It is also important to identify an outlet in the organization that will enable the team to build the right model with the appropriate computing power for both training, testing, and validation as well as deployment.[61] There are resources that might help host and run an AI solution, including the Air Force Research Laboratory's redForce AI.[62]

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58. Anderson, Losito, and Batir, "Commander's AI Smartcard," para. 9.
59. Lawrence, "Data Readiness Levels."
60. Harrison and O'Neill, "Ready for AI."
61. Anderson, Losito, and Batir, "Commander's AI Smartcard," para. 13.
62. "Modernized Acquisition of AI."

Phase 4: Implementation

A timeline for the actionable items will provide a framework to guide implementation. Specifically, the timeline should include when and how long each step will take to accomplish. It is also important to determine if the steps will occur in a specific order or at the same time. Specific, measurable key performance indicators allow the success of each action to be evaluated as it relates to the original project goal. If the project does not sufficiently meet the project goal, the key performance indicators should be prescriptive enough to pave a pathway for future projects.

A human-centered approach is critical.[63] With emphasis on the user, leaders should engineer the lifecycle of the solution to collect, transfer, and curate data using the following questions: how will the model be trained and improved with feedback from users? How will the users interact with its predictions? How will these goals be incorporated into day-to-day operations and give value back to the team in time saved or increased mission effectiveness?

Phase 5: Limitations

Lastly, the project's limitations need to be assessed. One possible limitation might be funding the development of the solution. For example, the feasibility of leveraging a local engineer's time and resources for this project might be considered. This manpower might then be replaced by a free open-source product or a purchased proprietary tool. Another important limitation is cultural fit. The solution may need to be redesigned so that the organization can fluidly sustain and iterate on the work.

Conclusion

To bolster AI readiness in the US Air Force, commanders at the squadron level must inspire grassroots data-centric innovation and subsequently integrate artificial intelligence. A squadron commander can inspire innovation by first establishing a concrete data strategy. They can support this strategy by building better data infrastructure, cultivating talent across the organization, redesigning the squadron, and growing a culture of innovation. Data-centric transformation happens at the warfighter level, and the squadron commander is the essential change agent who will spark the flame of AI readiness.

A commander can build upon a data-centric unit by encouraging AI integration into organizational processes. To do this, they should follow a rigorous AI ideation process to spark innovation at the grassroots level. Specifically, this ideation process guides Airmen through five distinct phases: (1) diagnosis, (2) goals, (3) actionable steps, (4) implementation, and (5) limitations. By following this flow, squadrons can enable Airmen to translate the unit's data resources and infrastructure into tangible productivity gains. These productivity gains will strengthen and ready the Air Force for digital warfare.

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63. Lauren Landry, "What Is Human-Centered Design?," Harvard Business School Online, December 15, 2020, https://online.hbs.edu/.

ORGANIZATIONAL CHANGE

Dual Allegiance in Military Healthcare

US Air Force and Defense Health Agency Convergence

Daniel J. Watson
Christopher Paige
Douglas J. Robb

Recent congressionally directed changes gave the Defense Health Agency authority, direction, and control of military treatment facilities. But limited authorities resulted in the agency's pursuit of capacity, typically measured via medical productivity standards. The Air Force maintains command authorities to organize, train, equip, and provide capabilities, including medical, to the combatant commander. These dual authorities converge at the military treatment facility, producing a conflict between capacity and capability. Tension, already present due to the dual nature of the mission to provide support and healthcare delivery to beneficiaries, has increased and threatens the Air Force's ability to medically support combat operations, generating risk to the operational mission. With the increasing likelihood and stakes of armed conflict, senior leaders can mitigate the risk to the operational mission by decreasing the tension and risk at Air Force MTFs.

The October 2022 US *National Security Strategy* identified the People's Republic of China (PRC) as "America's most consequential geopolitical challenge."[1] Framed as great power competition, the narrative in the strategy contends China has the ambition and intent to reshape the international world order.[2] Building upon the *National Security Strategy*, the US secretary of defense identified China as the "pacing challenge" in the October 2022 *National Defense Strategy*.[3] More specifically, the *National Defense Strategy* identified four priorities for the Department of Defense, one of which is "deterring

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1. Joseph R. Biden Jr., *National Security Strategy* (Washington, DC: The White House, October 2022), 11, https://www.whitehouse.gov/.
2. Biden.
3. Lloyd J. Austin, *2022 National Defense Strategy of the United States of America* (Washington, DC: Office of the Secretary of Defense (OSD), October 2022), 2, https://media.defense.gov/.

aggression, while being prepared to prevail in conflict when necessary—prioritizing the PRC challenge in the Indo-Pacific region."[4] In line with the strategic guidance, each US military department (MILDEP) is preparing for potential conflict.

Rapidly deployable and employable combat weapons systems form the backbone of the Air Force's ability to achieve strategic and operational objectives in support of a desired political end state. Yet combat weapons systems require combat support. Medical support is a crucial enabler of combat operations. As far back as the US Civil War, its purpose of supporting combat forces was considered essential yet underappreciated:

> A Corps of Medical Officers was not established solely for the purpose of attending the wounded and sick; the proper treatment of these sufferers is certainly a matter of very great importance, and is an imperative duty, but the labors cover a more extended field. The leading idea, which should be constantly kept in view, is to strengthen the hands of the Commanding General by keeping his army in the most vigorous health, thus rendering it, in the highest degree, efficient for enduring fatigue and privation, and for fighting.[5]

While this viewpoint from 1866 still applies, medical personnel perform additional functions such as aeromedical evacuation, radiological decontamination, water testing, and more in today's environment. The significance of their role in supporting combat forces is perhaps best exemplified in the operations in Iraq and Afghanistan early in the twenty-first century. In these operations, medical support achieved the greatest injury survivability rate in US history. This was largely due to relatively short distances to advanced medical capabilities, effective mission command, and robust communications. Even so, this was done in an uncontested air environment, which allows for quick access to such advanced medical capabilities. This may or may not be the case in future conflicts.

Military healthcare capability represents the ability to provide medical support in direct support of combat operations. Capability is "the ability to complete a task, perform a function, or execute a mission—under specified conditions and to specified standards of performance."[6] Thus, such capability is required for effectiveness. For example, radiological decontamination represents a specific healthcare capability. Conversely, military healthcare capacity measures the system's ability to provide care to a patient. Capacity is typically measured by productivity standards based on civilian healthcare benchmarks, such as the number of patients seen per week by each provider type.

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4. Austin, 7.

5. Jonathan Letterman, *Medical Recollections of the Army of the Potomac* (New York: D. Appleton and Company, 1866), 100–101.

6. Chairman of the Joint Chiefs of Staff (CJCS), *Joint Warfighting*, Joint Publication (JP) 1, Vol. 1 (Washington, DC: CJCS, March 25, 2013, incorporating change 1, July 12, 2019), 18.

Challenges Posed by Anticipated Near-Peer Conflict

Air supremacy, mission command, and communications will be challenged within the Indo-Pacific theater in a conflict with China. While this paper will focus on the Indo-Pacific region, its findings also apply to the European theater. The size of the Indo-Pacific area of operations will add tension and risk to combat operations, combat support, and mission command. Some levels of strategic tension and risk are acceptable and even generally preferred; however, as the tension between elements such as time, energy, resources, equipment, distance, information, and system inputs increase, greater volatility, uncertainty, complexity, and ambiguity (VUCA) result, increasing overall risk to the mission.

During combat operations, such tension, VUCA, and risk escalate, and this in turn can affect operational, strategic, and political objectives. Each component must manage risk to provide and while providing forces to the appropriate combatant commander. To help the Air Force manage or mitigate tension and risk to the greatest extent possible, successful combat operations and support "in a contested environment demand maximum delegation, trust, and empowerment of Airmen before the conflict starts."[7] One mitigation measure included in Air Force doctrine directs the organizing, equipping, and training of combat operations and combat support units as they will fight.[8]

Recent congressionally directed changes gave the Defense Health Agency (DHA)—the DoD combat support agency responsible for "fulfilling combat support functions for joint operating forces across the range of military operations" and health service support to the military community—authority, direction, and control over all military treatment facilities (MTFs), while the US Air Force retains command authority. Yet as great power competition increases the likelihood and stakes of armed conflict, because of DHA's new role, the Air Force must now resolve the increased tension and risk at the MTF level to prepare to support combat operations medically.

Background

Before 1993, the Air Force Medical Service (AFMS) did not have squadrons or a squadron commander, unlike its line of the Air Force counterparts.[9] Like civilian hospitals, functional leaders ensured clinical care and quality; the hospital commander retained command authority and responsibility. This changed in 1993 when the US Air Force chief of staff directed the surgeon general to adopt the Objective Wing Model to focus on operational readiness.[10]

7. Charles Q. Brown Jr., *Accelerate Change or Lose* (Washington, DC: Department of the Air Force [DAF], August 2020), 6, https://www.af.mil/.

8. DAF, *The Air Force*, Air Force Doctrine Publication (AFDP) 1 (Washington, DC: DAF March 2021), https://www.doctrine.af.mil/.

9. Merrill A. McPeak, *Selected Works: 1990–1994* (Maxwell AFB, AL: Air University Press, August 1995).

10. Wade B. Adair, *The Objective Medical Group Next Gen: Outdated or an Overhaul?* (research report, Air War College, Air University, Maxwell AFB, AL, February 22, 2018), https://apps.dtic.mil/.

The Objective Wing Model organized the Air Force around a functional unit, the squadron. The model remains in place today to include within the AFMS. A commander leads the squadron and is empowered by law with the authority, accountability, and responsibility to execute the mission, lead people, manage resources, and improve the unit to provide the geographical combatant commander with the appropriate capabilities and capacity to launch their respective operational plans.[11]

The squadron commander, typically a lieutenant colonel, is given these authorities via G-series orders from the next higher-level commander, typically a group commander. Each medical group (MDG) continues to have functional leaders—the chief medical officer, administrator, chief nurse, chief dentist, and the biomedical science corps executive—that focus primarily on clinical care and quality. Some squadron commanders are dual-hatted as functional leaders, providing them with additional responsibilities.

In 2013, the Defense Health Agency arose from the TRICARE Management Activity, a government entity responsible for managing healthcare benefits for active-duty personnel, retirees, and family members. In 2017, via the annual National Defense Authorization Act and due to ever-increasing healthcare costs within the DoD's budget, Congress required the military health system of the three military departments to move under the DHA's authority, direction, and control.[12]

The law's original intent included consolidating all MTFs within the continental US (CONUS) under DHA to deliver efficient and standardized healthcare; those MTFs outside the continental US (OCONUS) would remain with the military departments.[13] Military treatment facilities exist on OCONUS bases to enable a forward force presence in support of the respective combatant commanders, with a real possibility of supporting combat operations in place, especially in South Korea or Japan, but also at European bases, as was done during the 2011 Operation Odyssey Dawn in Libya. Business efficiencies are needed at these locations, but not at the sacrifice of their capability to support operational plans. Yet the Department issued a directive in September 2021 that placed all MTFs under DHA.[14]

Like the Air Force Medical Service organization before 1993 and the current organization of the US Navy and the US Army Medical Services, the functional unit within the Defense Health Agency is the military treatment facility. In the Indo-Pacific theater, a director leads each MTF and reports to the DHA regional director, who in 2023 is an Army two-star general. A similar relationship exists in Europe, but within CONUS, an intermediary organization called the market might be present between each MTF and the region. The region director then reports to the director of the DHA. The markets and

11. DAF, *Commander's Responsibilities*, Air Force Instruction (AFI) 1-2 (Washington, DC: DAF, 2014).
12. National Defense Authorization Act for Fiscal Year 2018, Pub. L. 115-91 (2017).
13. Joseph Heck (Nevada state representative), personal communication with authors, April 12, 2022.
14. Heck; and Department of Defense (DoD), *Defense Health Agency (DHA)*, DoD Directive 5136.13 (Washington, DC: DoD, March 2, 2022), https://www.esd.whs.mil/.

regions are all new organizations with new and additional human resources, budgetary, and infrastructure requirements.

The DHA director delegates authorities and the responsibility for administering and managing patient care to the MTF director.[15] Additionally, the MTF director leads an executive staff commensurate with the size of the facility and must be a colonel or someone of greater rank.[16] The executive team most commonly consists of leaders such as the chief medical officer, administrator, chief nurse, and chief dentist, who advise the MTF director from their functional lane. Squadron commanders, or a squadron, are not part of the DHA lexicon or structure.

Except for several facilities, the military treatment facility is generally equivalent to a medical group within the Air Force. A dual-hatted colonel leads both and is designated the MTF director and MDG commander. While MTFs and MDGs may appear synonymous, they differ in their authority sources. An MTF director has DHA authorities, while the MDG commander has MILDEP-specific authorities. While there is some delineation of DHA and Air Force authorities, roles, and responsibilities that may appear supportive of each other at a superficial level, at a deeper level, because the two sources fundamentally prioritize capability and capacity differently, they are in direct conflict with each other, increasing the tension and risk that converge at the squadron and group commander level.[17]

Recent contamination in an installation's water supply highlights this conflict.[18] Line of the Air Force leadership sought medical expertise to ensure public safety and to maintain deployment medical capabilities while adjusting the expectations of medical personnel over the three-month emergency. The Defense Health Agency initially deemed the emergency an environmental concern before eventually recognizing the possible medical impacts. Yet DHA continued to seek justification for the lost capacity, or productivity, throughout the emergency when the facility did not have drinkable water for more than three months. The conflict between capability and capacity increased tension, producing increased risk at the facility.

Capacity versus Capability Tension and Risk

The combatant commander's operational plans levy requirements on the military departments, and they build their structure to provide forces with specific capabilities to the combatant commander to execute their plans. In the Air Force, the squadron commander organizes, equips, and trains their squadron to provide forces and capabilities to the combatant commander. To do this, the Air Force recently approved a new force generation

15. DoD, *DHA* .
16. DoD.
17. DoD; and DAF, *Commander's Responsibilities*.
18. "Drinking Water Incident Response at Joint Base Pearl Harbor-Hickam, Honolulu, Hawai'i (November 2021–March 2022)," Environmental Protection Agency (website), accessed July 7, 2023, https://www.epa.gov/.

model.[19] Still, the AFMS must determine how the model will apply to medical forces. This adversely affects the AFMS because the narrative is externally defined and driven. Conversely DHA does not provide forces to the combatant commander.

With Congress' charge to gain healthcare efficiencies and standardization, DHA focused on military healthcare capacity rather than capability. As mentioned above, healthcare capacity is a measurement of the system's ability to provide care to a patient and is typically measured by productivity standards set by civilian healthcare benchmarks. Capacity lies within the DHA's authority. Thus, the agency set productivity standards as the benchmark, utilizing civilian healthcare productivity standards as the model.

At the same time, DHA is attempting to equate patient care with capability to maintain its relevance to the combatant commanders. For example, a patient visit to their primary care provider is typically viewed as meeting a productivity standard or capacity. The DHA interpreted the meaning of this visit to fit the definition of capability, which is outside the authorities given by Congress. This would be appropriate if the medical provider and team only provided healthcare. During daily operations or in contingency environments, however, Air Force medics are held responsible for many more capabilities.

The DHA's emphasis on capacity over capability increases the tension and risk within the Air Force Medical Service MTFs because of improper staffing models. Before the DHA assumed authority, direction, and control, staffing models historically gave the Air Force commander flexibility to balance capacity and capability locally. Unfortunately, staffing models within the AFMS now create greater tension and risk due to the DHA's emphasis on capacity over capability, directly impacting the MTF budget.

The Army and Navy are in less jeopardy for tension and risk as their civilian personnel within their MTFs (approximately 76 percent and 45 percent, respectively) can provide capacity while their active-duty personnel balance the pursuit of capabilities with capacity. The AFMS manning model relies upon a more significant percentage of active duty to civilian personnel (approximately 83 percent and 17 percent, respectively) to provide care in their respective MTFs.[20] While some civilian personnel within the Air Force Medical Service provide home-station medical capabilities, all active-duty personnel provide both home-station and deployed medical capabilities, requiring additional initial and sustainment training and repetitions.

In establishing productivity standards based on civilian healthcare productivity to measure capacity, the Defense Health Agency used civilian standards that came from clinics that maximized productivity and did not have a military-specific healthcare capability mission to meet. Thus the DHA standards are blanket standards without any local requirement considerations. For example, a provider in Osan, South Korea, is expected to

19. David W. Allvin, "Key Terminology for USAF Force Presentation and Employment Approaches," official memorandum, 2022.

20. Alfred K. Flowers Jr., "Strategic Landscape" (Presentation, AFMS Senior Leader Workshop, National Conference Center, Leesburg, VA, December 6, 2022).

meet the same productivity standards as a provider in Columbus, Mississippi, even though the readiness training requirements are vastly greater in Osan.

In addition, DHA calculates the fiscal year budget for a facility based on its projected productivity given their respective staffing like a for-profit civilian healthcare organization. If productivity is not met for any reason, including capability requirements, the facility will have money taken from its budget. By the DHA linking capacity to an annual budget, the AFMS' current staffing models have shifted to the emphasis on capacity, inserting stress into daily operations and risk to future combat military support because of the lack of emphasis on capabilities.

Differing Authorities

Differences in higher headquarters' command and control (C2) due to different authorities also increase tension and risk. As with all MILDEP components, the US Air Force's primary mission is to provide capabilities to the combatant commander to support operational plans, including medical. Capacity plays a role, but not at the cost of the capability. Commanders at and above the squadron level are empowered to balance capability and capacity by assuming risk via mission command. At the same time, they are held accountable for their decisions.

Risk is well-defined in Air Force instruction; every line item must list a waiver authority, forcing commanders to process *how* they should think about risk rather than *what* to think about risk.[21] Mission command culture allows the squadron commander, or a commander at any level, to pursue a waiver via the appropriate authority for any requirement by justifying the local environment that warrants the waiver. This mission command culture allows risk to be defined and assumed at the proper level, which enables the commander room to operate and make decisions based upon the identified risk and local conditions.

It also ensures guidance is nonproscriptive and helps capability and capacity remain balanced. Ultimately, this prepares commanders for the dynamics of combat operations and combat support operations through mission command or centralized command, distributed control, and decentralized execution, especially in the Indo-Pacific theater where communication will likely be degraded or absent in the event of a conflict.[22]

Conversely, because DHA emphasizes capacity over capability due to the limitations of its authorities, the agency's guidance and instructions provide proscriptive centralized command, centralized control, and centralized execution. Instructions tell the reader *what* to think rather than *how* to think about operations. This centralized command,

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21. DAF, *Publications and Forms Management*, AFI Instruction 90-160 (Washington, DC: DAF, April 14, 2022).

22. DAF, *Command and Control*, AFDP 3-30 (Washington, DC: DAF, 2020).

control, and execution is evident in the comparative number of instructional publications. The AFMS has 91 current publications, while DHA has 270.[23]

These mission command differences between the AFMS and DHA force the group and squadron commander to determine where the authority arises. During the coronavirus (COVID-19) pandemic response peak, DHA produced central guidance to be used within several days after any Centers for Disease Control and Prevention updates. Such guidance offered little room for local interpretation or application.

Conversely, the Air Force encouraged quick adoption, leaving the medical group commander to determine with their local line of the Air Force leadership how best to apply and implement any updates for the installation. This resulted in two policies, one for the MTF and one for the rest of the installation, creating tension and risk. The military departments' secretaries and service chiefs highlighted this risk and its implications to the mission.[24] Proscriptive command, as DHA currently provides, does not prepare the unit commander for mission command in a conflict.

Readiness Requirements

Every Air Force MTF must maintain a contingency medical response capability at the home station and in a deployed environment for activation in an emergency or natural disaster requiring medical capabilities.[25] The other MILDEPs maintain similar capabilities. These response capabilities may contain different clinical care teams, such as a disaster mental health team. A larger facility may have more robust capabilities, such as surgical and inpatient care teams.

In three primary roles, military training and exercises are required to train, practice, and refine for noncombat and combat medical support. First, every Air Force active-duty medic is assigned a position to fulfill in the event of a home station noncombat medical response. For example, a pediatrician may be assigned to a clinical or triage team. In a mass-casualty event or local disaster, the pediatrician would serve on this team until deactivation.

Secondly, based on their specific Air Force Specialty Code or job, every medic completes annual functional requirements to provide a job-specific capability for a combatant command operational plan. For example, a medical technician must maintain their National Emergency Medical Technician Certification to deploy in this role. Still, most medical technicians do not work in an emergency room or respond to emergencies in an ambulance, requiring additional time for sustainment training.

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23. DAF E-Publishing, "Publications and Forms," DAF, accessed January 5, 2023, https://www.e-publishing.af.mil/; and DHA, "DHA Publications Library," Health.mil, accessed January 5, 2023, https://www.health.mil/.

24. Ryan D. McCarthy et al., "Military Health System Medical Reform," official memorandum, August 5, 2020.

25. Air Force Surgeon General (AF/SG), *Health Services*, AFDP 4-02 (Washington, DC: AFMS, 2019).

Thirdly, a medic can be assigned to a functional team that deploys with a specific capability. For example, the pediatrician or the medical technician can be assigned to a team that, if activated by a combatant commander, deploys to a chemical, biological, radiological, or nuclear event to provide a decontamination capability.

These three examples represent separate scenarios, but the same individual can be tasked with all three responsibilities simultaneously or independently. The Air Force clearly defines and standardizes most functional initial, sustainment, and refresher requirements (example two). Yet home-station medical response (example one) and functional deployment team (example three) requirements must be better codified centrally.

For example, a home-station medical response capability is required, but the local commander determines initial, sustainment, and refresher training and exercise requirements are what is needed.[26] Nevertheless, the commander is still held to DHA's central productivity standards, or capacity. While some of the care provided would be like the performance of their regular duties, high-volume patient care does not ensure individual proficiency and capability for home-station or deployed readiness requirements. Individuals from across the facility are also brought together to form these teams. Highly reliable teams require time for training and repetition through exercises to be effective and safe. Lastly, the medic can be and is likely reassigned to different teams when they move every two to four years.

Medical Mission Command

Beyond the training and exercise requirements identified earlier in the paper, mission command is essential to maximizing an effective and safe response, regardless of the size and scope of the medical response capability. Mission command allows the commander to "identify and assess requirements, allocate means, and integrate efforts . . . to determine the status of organizational effectiveness."[27] At the broad level, mission command within an Air Force MTF during a contingency medical response typically involves the integration of four key personnel into two teams.

Two personnel, the medical group commander and one other individual—typically the deputy commander who is commonly a dual-hatted squadron commander at smaller facilities or a stand-alone deputy at a larger facility, or one of the squadron commanders—are part of the wing or installation crisis action team (CAT). The team brings together the senior leaders from the installation with an operations center to ensure effective C2 of the entire scope of the emergency among the fire department, security forces, medical, public affairs, and other agencies on the installation. In addition, this structure facilitates central communication with higher Air Force headquarters and organizations outside of the installation as needed.

26. AF/SG.
27. CJCS, *Joint Campaigns and Operations*, JP 3-0 (Washington, DC: CJCS, June 18, 2022).

The other two personnel, typically squadron commanders, provide internal mission command into the medical group via a central node, the medical control center (MCC). The medical staff on the CAT and the MCC coordinate identification, assessment, allocation, and integration efforts but focus their efforts externally and internally on the military treatment facility.

More specifically, US Air Force MTF mission command, through a cyclical feedback loop, identifies and assesses medical threats to forces, advises senior military operational commanders on the medical threats, and allocates means while integrating efforts internal and external to the organization to reach maximal effectiveness. The DHA addition adds another input and output. While the Defense Health Agency could be integrated, the crisis action team is administered by nonmedical personnel who work for the installation commander, adding additional layers to reach the MTF director. If the medical control center were the integration source, it would force its internal focus to include external efforts. The integration of DHA still needs to be defined during contingency responses, creating tension and increasing risk to the mission.[28]

Air Force Combat Operations Medical Support

While the Defense Health Agency assumed authority, direction, and control of nearly every MTF in 2021, several notable exceptions exist. Air Force MTFs in the US Central Command theater, such as the 379th, 332d, and 386th Medical Groups, remain under the Air Force's authority, direction, and control due to their direct combat support of ongoing operational missions in the Middle East. Additionally, these facilities do not use Defense Health Program funding; their funding comes from the US Air Force. The MDG commander is not dual-hatted as the MTF director; the position does not exist at these facilities.

These military treatment facilities are 100 percent staffed by active-duty members who fall under the mission command of their squadron, group, and wing commander through clear lines of authority. Training and exercises occur with regularity to ensure highly reliable teams. Productivity standards, or capacity, are considered, but not at the expense of maintaining capabilities. The medical group commanders are integrated into the installation CAT, while the squadron commanders integrate the military treatment facility through the MCC.

In this environment, the focus is on capability over capacity to ensure the Joint warfighting operational function of protection is postured to support when and if needed.[29] For example, Operation Allies Refuge facilitated the evacuation of more than 100,000 people from Afghanistan. Because the above MTFs remained under Air Force authority, direction, and control, the MDG and squadron commanders shifted medical capabilities to support the operational mission without approval or input from DHA.

28. McCarthy et al., "Military Health System."

29. CJCS, *Joint Campaigns*.

The Air Force Medical Service will support combat operations through medical capabilities. Every Air Force MTF within the USINDOPACOM and USEUCOM theaters currently falls under DHA's authority, direction, and control. The current ambiguity of how the AFMS will support these operations generates tension at OCONUS MTFs. If a conflict arises, a mechanism or trigger does not exist to "flip" the MTFs back to service authority, direction, and control to operate like those within the USCENTCOM theater.

Recommendations

Recognition of the tension between the Air Force Medical Service and Defense Health Agency at the group and squadron commander levels is the first step to reducing risk. The US Air Force surgeon general recently acknowledged the tension publicly for the first time.[30] The second step is more complicated as it involves managing and mitigating the tension and risk within the military treatment facility. From the MTF perspective, minimal actions have occurred to do so.

At first glance, the removal of DHA's authority, direction, and control by Congress may appear to be the logical solution. Another possible solution may be the elimination of each of the separate medical services. This article, however, proposes a more nuanced approach. While the recommendations outlined below are not exhaustive, AFMS senior leaders, as well as MDG and squadron commanders, should "pursue until apprehended" to solve this problem in advance of possible conflict.[31]

Defining Capacity and Capability

The AFMS must define capability and capacity and develop a purposeful narrative with prioritization guidance to minimize risk based on combat operational medical support requirements. The definitions must support the current and future requirement that routine patient care may not be equitable to patient care or capacity. Additional training is likely required to gain, maintain, and build capabilities for requirements.

This narrative, guidance, and the associated costs must be communicated regularly and often up the chain of command, laterally to other organizations, and down the chain of command. Specifically, up the chain of command, within the Military Health System executive review meeting, chaired by the Under Secretary of Defense for Personnel and Readiness, an opportunity exists to advocate for Air Force equities.[32] At this meeting, the Military Health System lines of effort and plans are integrated with the Department of

30. Shireen Bedi, "Air Force Medical Leaders Discuss Future Operational Challenges, Solutions at Annual Workshop," AFMS, December 14, 2022, https://www.airforcemedicine.af.mil/.

31. Theresa Hitchens, "CSAF Brown Mulls Streamlining of Air Force Commands; Barrett Announces 'e' Aircraft," Breaking Defense, September 14, 2020, https://breakingdefense.com/.

32. John J. DeGoes, "Scene Setter . . . AFMS & Military Health System Transformation" (presentation, AFMS Senior Leader Workshop, National Conference Center, Leesburg, VA, December 6, 2022).

Defense.[33] The under secretary and US Air Force vice chief of staff represent and advocate for the AFMS by providing input, concerns, and recommendations.[34]

In addition, recurring conversations between the Air Force surgeon general, surgeon general's leadership team, medical group, and squadron commanders must occur to inform, obtain feedback, and clarify the conflict between capability versus capacity tension and risk narrative. Major command surgeons general and their respective staff should also be a part of this conversation as they are integral to planning and oversight, but the Air Force surgeon general and staff should have these conversations to obtain direct feedback from the field.[35]

Additionally, capability and capacity must be built into the medical vernacular and included in all foundational courses, such as officer technical, Basic Leader Airman Skills Training, Intermediate Executive Skills, and precommand training courses. While line of the Air Force group and wing commanders attend a precommand course that includes an overview of the AFMS, additional education is needed to expound the tension within the AFMS and the subsequent risk this poses to their operational missions. Ideally, this information should come from the Air Force surgeon general, but it must be reinforced locally by MDGs and squadron commanders.

Once the Air Force Medical Service defines capability and capacity, MTF staffing models must be studied to ensure the correct mix of staff are present to balance the tension and risk to the Air Force operational mission at each location. Home-station contingency response team requirements should be considered and centrally defined when addressing AFMS staffing models. Knowledge, skills, and abilities should be defined centrally to standardize operations across the Air Force. Additionally, home-station contingency response teams could be defined by Air Force Specialty Codes to gain training efficiencies through standardization, allowing for more time to conduct training and exercises.

Differing Authorities

The AFMS must advocate through senior leaders such as the secretary, chief of staff, and chief master sergeant of the Air Force to refine DHA authority, direction, and control over all MTFs to only those within CONUS. Due to their direct support of combatant command operational plans, MTFs within the Indo-Pacific and European theaters should be aligned to the respective military departments for command, authority, direction, and control authorities, like those in USCENTCOM. Realignment would sustain the law's original intent of standardizing MTF operations to gain fiscal efficiencies within CONUS.

Yet due to casualty projections, capacity will be needed in a conflict with a peer or near-peer adversary. Shifting DHA's authority, direction, and control to CONUS-only facilities focuses efforts to standardize operations and gain efficiencies, decreases the ca-

33. DeGoes.
34. DeGoes.
35. AF/SG, *Health Services*.

pability versus capacity tension, and decreases the overall risk to combat operation medical support at MTFs outside of the continental United States. MILDEP command and control of medical services during expeditionary operations is directed by Joint guidance but should be updated to reflect the current environment.[36] If DHA realignment is not accomplished, capability and capacity tension will remain at OCONUS military treatment facilities, thus increasing the risk that their personnel are unprepared to support combat operations.

The Air Force Medical Service must correct the dearth of senior medical representation from all corps—biomedical science, dental, medical, medical service, and nurse corps—within the Defense Health Agency. This can be done by ensuring the Air Force is adequately represented by an officer, enlisted member, and civilian personnel at all levels, especially leadership. Four out of 17 DHA leaders are from the Air Force; only three of the four have medical command experience.[37]

To accurately represent and advocate for Air Force equities and culture, command at the squadron and group level should be a prerequisite, as much as possible, so the tension and risk between capacity and capability can be articulated and represented. Some may consider a move from AFMS to DHA a lateral move; Joint credit should be established or granted in critical positions to overcome this.

Lastly, medical strategy and policy at all levels must be revamped to decrease tension and risk. Topics such as mission command, definitions of capability and capacity, command-and-control relationships, supporting and supported agencies, waiver processes, and waiver authorities must be included. Medical training facilities within CONUS should have a contingency redline, or tripwire, to switch from DHA authority, direction, and control back to the respective US military department to ensure the worldwide and local mission is met.

Readiness and Air Force Combat Operations Medical Support

The Air Force Medical Service must quickly update its deployment model to incorporate it into the new US Air Force Force Generation (AFFORGEN) model. While this work may have started centrally, communication and transparency with the rest of the AFMS do not yet exist, so local initiatives have begun at many locations. To overcome this, regular communication, with transparency, should occur with the medical group and squadron commanders. The AFMS must also determine the capabilities needed to build the team. For example, the Air Force is increasing the Indo-Pacific theater's critical care air transport teams.

While necessary, air transport can only occur infrequently in a contested air environment. This means patients may need prolonged care at or near the point of injury. Yet

36. CJCS, *Joint Health Services*, JP 4-02 (Washington, DC: CJCS, December 11, 2017).

37. Military Health System, "Our Leaders: Health Affairs Leaders," Health.mil, accessed February 3, 2023, https://www.health.mil/.

without air transport, the logistics of prolonged care will likely become an issue due to limited resources. This produces an ethical and moral dilemma. Is it better to save one or a few individuals but decrease resource availability for future casualties? Or to protect limited resources? The best decision may be to focus medical efforts primarily on mission regeneration or the return to duty of personnel while secondarily focusing on surgical, prolonged care, and critical care air transport to minimize the overall risks to the mission. These capability discussions and decisions must occur frequently and with transparency. Clear policy and guidance must follow to establish priorities and explain why.

Once this is defined, the AFMS must be part of every operational training and exercise at the local, wing, Joint, partner, and Allied levels to build and sustain the capability. This means AFMS must be a part of the planning, execution, and debriefing to ensure realism, learning, and accountability. It also reinforces the mission command structure that will be used in the event of a contingency. This develops the narrative of how AFMS supports combat operations and the cost of sustaining this capability.

It is also unknown how AFFORGEN will generate medical forces to meet Joint medical requirements. This is because Joint medical requirements are largely undefined. The Air Force Medical Service and Air Force should advocate through the chief of staff of the Air Force to the Joint Staff to codify the Joint requirements before codifying AFMS requirements within the AFFORGEN model. Ultimately, disparate thrust leads to an inconsistent narrative and vector, resulting in the symptoms, and not the problem being addressed.

Additionally, the AFMS must define home-station contingency response capabilities and training. Every Air Force installation and surrounding civilian community should be examined to define the local requirement. Once the requirement is identified, the MTF capability can be right-sized. Reexamination should occur with recurring frequency.

Medical Mission Command

To maintain its mission of supporting combat operations with medical capabilities, the Air Force Medical Service must latch itself into US Air Force command-and-control functions at the service, major command, numbered air force, wing, and detachment levels. These levels are already integrated into the combatant commander's component C2 structure, usually through the commander, US Air Force forces, or the Joint Force air component commander.

Mission command requires identification and analysis, and if the appropriate authorities exist, an assumption of risk when appropriate. Mission command also requires the employment of forces as the Air Force organizes, trains, and equips these forces to minimize risk. This can only occur if both medical group and squadron commander positions are maintained. The MDG commander must integrate the group externally while the squadron commander integrates internally within the MTF. If squadron commanders are removed, medical integration will be threatened externally and internally due to the tension of time and energy at the MDG commander level. The Air Force's lean MTF staffing model requires some depth at the commander level. A noncommander may not fully understand the tension and risk of capacity versus capability and does not have the legal authority to assume the risk.

While there have been calls for a single medical department since the establishment of the Department of Defense, the AFMS must advocate against this, considering the current great power environment and the potential for conflict in the next 10 years. Integration of the Air Force, Army, and Navy medical systems could take place but would take years due to the different cultures, missions, and structures. In today's environment of great power competition, integrating now poses a real risk to each medical service's ability to support the combat operations of their respective military department and the Joint team. Instead, each MILDEP must maintain its responsibility as the force provider for their missions to the combatant commander to support operational plans and requirements. Additionally, each department must maintain the mission command of its medical forces.

While beyond the scope of this paper, the Air National Guard and Air Reserve have organic medical assets that should be assessed for tension and risk. Similar assessments should be undertaken as the Space Force considers its future medical capabilities.

Conclusion

As the likelihood and stakes of armed conflict increase, the Air Force Medical Service must prepare to support combat operations. Recent congressionally directed changes gave the Defense Health Agency authority, direction, and control over all military treatment facilities to gain fiscal efficiencies through the standardization of medical care. Considering this, DHA prioritized capacity. Yet the Air Force retains command authorities and is responsible for providing medical capabilities to the combatant commander to support operational plans and requirements. This creates a confluence of tension at the medical group and squadron commander levels within Air Force MTFs due to the conflict of capacity and capability priorities.

If the situation is left unaddressed or unmitigated, tension increases, and such an environment potentially worsens during combat operations. Increasing tension creates increased risk and decreasing unity of effort and command, whether at peace or in a conflict. If unaddressed, this risk can radiate upward to affect operational, strategic, and political objectives, and it can also spread downward to all medics. If tension and risk increase at the provider level, they will ultimately transfer to their patients. When lives are on the line, which in armed conflict they will be, the Air Force Medical Service must address and mitigate these issues by starting with the cause and not the symptoms. With the likelihood of conflict increasing, this must be solved now. Determining a solution while already under fire will cause deaths that could have been prevented.

Toxic Senior Military Leaders in the Cockpit

Joshua Bringhurst
Emma Palombi

Military pilots can become toxic leaders both in and out of the aircraft. Such pilots negatively affect a unit's performance, morale, and safety. If not corrected early in their careers, toxic pilots can continue to rise in rank and flight qualifications and can create an adverse environment that extends well outside the cockpit. To address the challenge of toxic senior military pilots, the Department of Defense should 1) improve the initial screening and training of aviation candidates, 2) train aircrew and senior leaders to identify and respond to toxic pilots, and 3) empower anonymous reporting.

On June 24, 1994, a B-52H Stratofortress, call sign Czar 52, crashed during an airshow rehearsal at Fairchild Air Force Base, Washington, killing the crew of four senior US Air Force officers. Aviation safety researcher and retired US Air Force officer Tony Kern's detailed investigation into what Air Force regulation officially reported as a Class A mishap—in this case, an airplane crash resulting in one or more fatalities—cited the causal factor as a senior pilot acting as a rogue aviator who intentionally broke Air Force flight regulations and abused the privileges of his rank and positional authority.[1] Complacent senior leaders further empowered this pilot by refusing to punish him following multiple flight violations and complaints from junior aircrew about his toxic behavior.

As officers, pilots can become toxic leaders both in and out of the aircraft. Such pilots negatively affect a unit's performance, morale, and safety. Within military aviation, a rogue aviator is a specific type of toxic pilot who knowingly breaks rules in the aircraft. Yet a toxic pilot is not always a rogue aviator. Toxic pilots can still operate within their communities' established rules, but their abusive behavior in the aircraft will still impact flight safety. If not corrected, toxic pilots can continue to rise in rank and flight qualifications and can create an adverse environment that extends well outside the cockpit. To address the challenge of toxic senior military pilots, the Department of Defense should 1) improve the initial screening and training of aviation candidates, 2) train aircrew and senior leaders to identify and respond to toxic pilots, and 3) empower anonymous reporting.

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1. Tony Kern, *Darker Shades of Blue: A Case Study of Failed Leadership* (self pub., 1995), https://convergentperformance.com/.

Background

Toxic leaders impact an organization's climate, culture, and morale. Often, junior members can become disillusioned with their organization as their attempts to bring attention to a toxic leader's behavior fail to be addressed by more senior leaders. The problem with toxic leaders worsens when their actions impact people's safety and lives. Toxic senior military pilots are particularly dangerous because they not only negatively affect their squadron and harm their service's reputation, but they also put people's lives at risk.

Within the US military, the Army is the only service to have officially defined toxic leadership, which it refers to as counterproductive leadership. Army Doctrine Publication (ADP) 6-22, *Army Leadership and the Profession*, describes counterproductive leadership as "preventing a climate conducive to mission accomplishment"; it "leaves organizations in a worse condition than when the leader arrived."[2] While the Army offers an expansive explanation of counterproductive leadership in the military, this article uses the broader definition of toxic leaders by noted sociologist and social psychologist Jean Lipman-Blumen as "those individuals who, by virtue of their destructive behaviours and their dysfunctional personal qualities or characteristics, inflict serious and enduring harm on the individuals, groups, organizations, communities and even the nations that they lead."[3]

Many flight students learn about the Czar 52 mishap during initial flight training, yet toxic senior military leaders continue to be a problem in the military.[4] Junior aircrew may recognize toxic leadership in the cockpit and rogue aviator characteristics but feel powerless to do anything if the leader is a senior pilot with years of flying experience and advanced flight qualifications.

The Czar 52 incident involved a rogue aviator, a specific type of toxic pilot who knowingly breaks rules in the aircraft.[5] According to Kern, in addition to commanding a high level of expertise, rogue aviators are "usually popular and respected, possess considerable social skills, and have learned what rules they can break, when, and with whom."[6] The combination of "this level of sophistication" and "high experience, skill, and confidence" enables such aviators to continue to appear as model pilots to more senior leaders.[7] Using

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2. Headquarters, Department of the Army (DA), *Army Leadership and the Professions*, Army Doctrine Publication (ADP) 6-22 (Washington, DC: DA, July 2019), 8-7, https://rdl.train.army.mil/.

3. Jean Lipman-Blumen, "The Allure of Toxic Leaders: Why Followers Rarely Escape Their Clutches," *Ivey Business Journal* (January/February 2005), under "Defining Toxic Leaders," https://iveybusinessjournal.com/.

4. Jason Lamb, "Why Toxic Senior Leaders Survive—and Sometimes Thrive—in the Military," *Air Force Times*, September 3, 2020, https://www.airforcetimes.com/; and Kenneth R. Williams, "The Cost of Tolerating Toxic Behaviors in the Department of Defense Workplace," *Military Review* (July/August 2019), https://www.armyupress.army.mil/.

5. Kern, *Darker Shades*.

6. Kern, under "Section One: Introduction, Key Concepts: Airmanship, Rogue Aviators, Leadership, and the Culture of Compliance."

7. Kern.

existing safety mechanisms to report toxic pilots can prove ineffective if the individual is a senior leader who is highly regarded by more senior officers.

The B-52H Disaster

The B-52H, Czar 52, crashed when the pilot turned the aircraft beyond a 90-degree angle of bank, exceeding established aircraft limitations. This caused the bomber to stall, which was unrecoverable at only 250 feet above ground level. The crash occurred following the completion of the airshow rehearsal as the crew was maneuvering the aircraft for a landing. Lieutenant Colonel Arthur "Bud" Holland flew as the pilot in command and was likely at the controls when the aircraft crashed. His reputation as a gifted aviator and his years of experience had earned him the position of chief of the 92d Bomb Wing Standardization and Evaluation branch, responsible for the enforcement of B-52H flight and evaluation standards within the wing. Yet despite his position and reputation, in the three years leading up to the accident, Holland knowingly exceeded aircraft limitations seven times in airshows, training exercises, and flyovers for change-of-command ceremonies.[8]

Lieutenant Colonel Mark McGeehan, the co-pilot and also the 325th Bomb Squadron commanding officer, had made several attempts to ground Holland for his unsafe behavior. In fact, McGeehan would allow his aircrew to fly with Holland only if he was in the aircraft as well.[9] Lieutenant Colonel Ken Huston flew as the navigator since the navigator initially assigned to the air show crew refused to fly with Holland. Colonel Robert Wolff, the 92d Bomb Wing vice commander, flew as a safety observer. The wing commander added Wolff to the flight the morning of the mishap.

A Deadly Course of Events

During the three years preceding the mishap, the high turnover rate within the 92d Wing's senior leadership and failure to document and properly punish Holland for his repeated flight violations created an environment in which his rogue aviator characteristics could flourish. Despite these violations and multiple warnings from other B-52H aircrew about Holland's conduct, 92d Wing leadership kept Holland in his position and allowed him to keep flying. The Czar 52 mishap stands out as a tragic incident in which senior leadership ignored all signs pointing to Holland as a toxic senior pilot and, worse, created an environment in which his toxicity could continue unchecked. Junior aircrew lost faith in their senior leaders as they saw a lack of consistency and fairness within the 92d Wing leadership. Established rules seemingly applied to every B-52H pilot except Holland.[10] The crash and resulting deaths of four Airmen was thus due to a single toxic

8. Kern.
9. Kern.
10. Tony Kern, *Czar 52: A Prelude to Disaster*, n.d., https://www.hptc-pro.com/.

senior pilot enabled by a group of senior leaders who failed to establish a healthy command climate and did not take disciplinary actions against a subordinate's misconduct.

Lessons Learned

The lessons learned from the Czar 52 crash and events leading up to it apply to any organization where a senior toxic leader can have an adverse impact that at its most extreme can turn deadly. The most significant and dangerous impact of toxicity in the cockpit is on flight safety. In this case, Holland had become a rogue aviator. He knowingly violated Air Force flight regulations and created an abusive cockpit environment in which no other aircrew could question his actions. Outside the aircraft, Holland used his rank and positional authority to dismiss any complaints against his behavior and harass anyone who spoke out against him.[11]

Rogue Aviators

Rogue aviators, especially those who are senior officers, can inspire equally bad behavior in junior pilots. The investigation into the Czar 52 crash noted that over the years, other junior B-52H pilots had attempted to emulate Holland's aggressive and unauthorized flight maneuvers in the aircraft. Despite many junior pilots refusing to fly with him, others viewed Holland as a role model.[12] Because junior pilots tend to look up to their more experienced colleagues, a toxic role model, specifically one who goes unpunished, can negatively inspire junior pilots who will possibly pass damaging behaviors on to the next generation.

Toxic Leaders

A toxic senior pilot damages the reputation of an entire organization. Squadron pilots opposed to Holland's behavior perceived a double standard in which wing leadership refused to acknowledge and punish the unprofessional airmanship of a pilot in charge of standardization and evaluations.[13] By not correcting toxic behavior, whether out of ignorance or willful neglect, the wing leadership eroded their credibility and trustworthiness.

The military's organizational culture consists of a rigid hierarchy and strict observance of established rules governing the interaction between junior and senior members. As a result, junior members may be reluctant to speak up when confronted with a toxic senior leader. Incidentally, this reluctance can be made even worse when reporting a toxic senior pilot, particularly one highly regarded by senior officials. Junior members may believe they might jeopardize their flight progression by challenging an experienced pilot with advanced flight qualifications.

11. Kern.
12. Kern.
13. Kern.

In addition, a pilot's reputation can inhibit senior leaders from objectively assessing toxic behavior. Holland's role as the 92d Bomb Wing's chief of Standardization and Evaluations and reputation within the B-52H community as a skilled pilot led the wing's multiple senior leaders to willfully ignore valid complaints about his behavior. Each new senior leader saw Holland's flight violations as a single incident and not a series of repeated infractions.[14] As Kern notes, "While outgoing leaders didn't fulfill their responsibility to inform new commanders, incoming commanders didn't ask the right questions."[15] By failing to document Holland's incidents and pass that information along to their replacements, and by neglecting to investigate prior complaints about Holland, the 92d Wing leadership enabled a toxic pilot's behavior and created an adverse command climate.

Tragically, toxic leadership continues to be a causal factor in fatal mishaps. A US Air Force C-17 crash on July 28, 2010, had disturbingly similar characteristics to the Czar 52 mishap.[16] More recently, toxic leadership was identified as a factor in the fatal crash of a US Navy T-45C on October 1, 2018, and the midair collision between a US Marine Corps F/A-18D and C-130J on December 6, 2018.[17] The Air Force and other services have likely not yet solved the problem of toxic leaders in the cockpit.

Recommendations

This article proposes three recommendations to identify, correct, and, if necessary, prevent a toxic pilot from growing in rank, authority, and flight qualifications. Military organizations at all levels must implement processes and procedures to address toxicity and minimize its impact. Taking a multifaceted approach, starting with initial recruitment and continuing throughout an aviator's career, the three recommendations involve selection and recruitment, training and awareness development, and empowering anonymous reporting for leadership accountability. Leadership expert George E. Reed offers similar suggestions when discussing how to mitigate toxic leadership.[18] These also include followers and supervisors identifying and directly confronting toxic leaders and supervisors providing personal counseling for an identified toxic leader. The following recommendations aim to identify and correct toxic traits prior to or early in an aviator's training and ensure such traits do not emerge over the course of their career.

14. Kern, *Darker Shades*.

15. Kern, under "Section Four: Conclusions and Implications, The Senior Leadership Positions Did Not Speak with Continuity."

16. Stephen Trimble, "C-17 Crash Report Exposes Cracks in USAF Safety Culture," Flight Global (website), December 17, 2010, https://www.flightglobal.com/.

17. Mark D. Faram, "Leadership Failures in Navy Pilot Training Squadrons Led to Tennessee T-45 Crash," *Navy Times*, April 14, 2018, https://www.navytimes.com/; and Megan Eckstein, "Marine Corps Finds 2018 Crash Investigation Had Flaws, Proposes New Safety Measures," United States Naval Institute (USNI) News, July 2, 2020, https://news.usni.org/.

18. George E. Reed, *Tarnished: Toxic Leadership in the U.S. Military* (Lincoln: University of Nebraska Press, 2015).

Selection, Recruitment, and Initial Training

The initial selection and recruitment phase should include an in-depth psychological screening of potential candidates that identifies toxic behavior. These screenings should specifically target narcissistic traits as they seem most common within toxic leaders in the military and are often the hardest to identify.[19] Observing and assessing candidates in role-playing scenarios designed to identify toxic behavior will also help complement any findings from a psychological screening. Depending on the toxic traits identified, a candidate could be denied entry into the service or made aware of this negative behavior and receive appropriate training to correct these deficiencies. This detailed initial assessment would be an extension of the more comprehensive leadership evaluation programs that many of the US military services are incorporating for their field grade officers.[20]

Correcting toxic leadership is much easier when the pilot is still junior in rank and flight qualifications. Research into toxic or destructive behavior has shown that it can be resolved with the appropriate intervention and help. A 2018 study recommends that first, "the destructive leader behavior needs to be assessed to understand it in terms of the target of the behavior and the level of hostility"; this should be followed by specific interventions, "for example, personal coaching for the leader can work on the specific harming behaviors."[21] If toxic leadership traits are identified early and the individual is provided tailored training, a potentially toxic leader can be turned away from the dark side of leadership. Specific to pilots, continuous assessments throughout flight training should be provided to any flight student identified as potentially toxic. If someone fails to show improvement, they should be removed from the flight program and possibly military service.

Training and Awareness Development

Aircrew should receive initial and annual training focused on developing techniques to identify and address toxic behavior in the cockpit. With a toxic leader in the cockpit, some members of the aircrew may assume the role of followers who can further empower the toxic leader. A detailed analysis on such dynamics states that followers can "give credibility to the leader and provide resources they need to continue to lead regardless of how destructive that leadership is. . . . These followers are usually the recipients of destructive

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19. J. A. Bourgeois et al., "An Examination of Narcissistic Personality Traits as Seen in a Military Population," *Military Medicine* 158, no. 3 (March 1993), https://pubmed.ncbi.nlm.nih.gov/; and Michael Piellusch, "Toxic Leadership or Tough Love: Does the U.S. Military Know the Difference?," War Room–Army War College, August 25, 2017, https://warroom.armywarcollege.edu/.

20. Philip Athey, "New 360 Degree Review to Start with Just 200 Marines," *Marine Corps Times*, November 27, 2021, https://www.marinecorpstimes.com/.

21. Ellen A. Schmid, Armin Pircher Verdorfer, and Claudia V. Peus, "Different Shades—Different Effects? Consequences of Different Types of Destructive Leadership," *Frontiers in Psychology* 9 (2018), under "General Discussion, Practical Implications," https://doi.org/.

behavior and tend to experience considerable harm."[22] Despite suffering under a toxic leader, aircrew who do nothing to identify, correct, and report this behavior become followers who enable that leader to continue their unsafe and unprofessional behavior.

Training to prevent aircrew from becoming followers who enable toxic leaders should start with studying, analyzing, and discussing previous aviation mishaps caused by a toxic pilot. Each service's respective aviation safety center should conduct the initial ground training and provide additional training material to squadron safety departments. Aviation safety centers can access years of relevant mishap data, receive current mishap reports, and provide unbiased training about toxic pilots and commands.

During advanced flight training and as part of annual aircrew training, the syllabus should include a flight training event in which an instructor simulates being a toxic pilot who negatively impacts flight safety. This specific training would focus on how to identify and address a toxic pilot during a flight. Aircrew should be trained to treat toxic behavior like any other safety-of-flight issue. The first step is to verbally identify the issue and offer constructive feedback to correct this behavior. If a pilot persists in behavior and actions which could jeopardize flight safety, the other crew members should directly express the intention to stop a flight maneuver or end the flight.

To clearly communicate a safety concern, standard aviation phraseology must be used. During a flight, the Air Force and many other services use the phrase "knock-it-off" any time an unsafe condition occurs.[23] This phrase is just as applicable to a situation involving a toxic pilot's unsafe behavior. Treating toxicity in the cockpit as a safety-of-flight issue allows aircrew to use an existing standardized approach to identify a hazard, make appropriate corrections, and, if needed, end the flight.

Military aviation is a highly demanding profession in which aircrew must build resiliency to operate their aircraft in a high-stress environment. To build such resiliency and avoid the misperception of toxic behavior being an instructional technique, aircrew training should emphasize the difference between constructive practices and destructive behavior to ensure that toxic conduct is properly identified. This will also help prevent junior pilots from attempting to emulate a toxic pilot when they gain instructor flight qualifications. The strong emphasis that aviation has on safety demands that no one should tolerate bad behavior in the cockpit.

The goal of this combination of ground and flight training is to ensure aircrew of all ranks and qualifications feel empowered in their assigned role in the aircraft to identify toxic behavior and respond to and report it appropriately. Having the tools and knowledge to identify toxic behavior is a good first step. The next step is practicing employing those skills in the aircraft to prevent aircrew from becoming followers who enable or mimic

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22. Ivana Milosevic, Stefan Maric, and Dragan Lončar, "Defeating the Toxic Boss: The Nature of Toxic Leadership and the Role of Followers," *Journal of Leadership & Organizational Studies* 27, no. 2 (2019): 131, https://doi.org/.

23. Secretary of the Air Force (SAF), *Flying Operations: Air Operations Rules and Procedures*, Air Force Instruction (AFI) 11-214 (Washington, DC: SAF, July 8, 2020), https://static.e-publishing.af.mil/.

toxic behavior. If properly trained, junior aircrew can stop their commanding officer from unsafe conduct in the aircraft.

Anonymous Reporting

If not already implemented, all squadrons should have anonymous reporting programs in place to give every member an opportunity to voice their concerns without fear of retribution. Anonymous reports help raise awareness of toxic behaviors and can be a valuable resource for commanders to evaluate personnel performance and morale. Access to anonymous reporting is typically limited to select members within a unit's safety department and the commanding officer. This helps protect anonymity and empower commanding officers with how they choose to address any identified issues within their command. Unfortunately, this limited access also allows a commanding officer to ignore or dismiss complaints about toxic leadership and behavior within their command or associated with themselves, thus creating a toxic barrier.

To ensure anonymous reporting can overcome such barriers, military organizations should introduce clear mechanisms and standardized procedures that make commanding officers accountable for monitoring their command climate and promptly addressing reports of toxic behavior among personnel. Yet while command climate surveys can be used to anonymously gain inputs about the health of a command and its leadership, the results of such surveys are limited to the commanding officer. This can present another barrier if the results are ignored or dismissed. As such, there should be a standardized procedure for bypassing any possible obstacles to reporting toxic behavior. Safety departments should be empowered to take any reports to their next higher headquarters if they feel their commanding officer is not correctly addressing identified concerns.

Filing an inspector general (IG) complaint is another option to report abusive behavior. Providing education on this process can serve as another means of improving reporting and holding toxic senior pilots accountable. Due to its legal requirements, the IG complaint process is more formal and lengthy than anonymous or direct reporting. Yet again, there are limitations to this process; the IG or the commander responsible for reviewing the IG investigation and determining what actions should be taken could dismiss the complaint.

In the case of Holland, it seems unlikely the wing leadership would have pursued any such reports, considering they dismissed evidence and other complaints about his toxic behavior.[24] Before this process can work, then, senior leaders must be receptive to feedback that impacts the command climate. Research discussing ways to detox organizations proposes that senior leaders must develop a strong "willingness to follow the goals of an organization instead of focusing on oneself, the ability to maintain a culture of transparency,

24. Kern, *Darker Shades*.

belonging, and accountability, and the courage to defend it. The latter might require disposing of toxic leaders who are harming the organization's reputation."[25]

For personnel to use anonymous reporting and develop trust in an organization and its leaders, personnel must see that their leadership handles anonymous reporting promptly and takes accusations of misbehavior seriously. Any reports of the commanding officer exhibiting toxic behavior should be automatically brought to the next higher headquarters. This higher command can then determine if the anonymous report comes from one disgruntled individual or several members making a justified complaint and begin to track if reports of toxic leadership become an unresolved trend within a command.

This should not be grounds for immediate removal from command, and the commanding officer should be allowed to defend any accusations of toxic leadership. For accusations of toxic behavior within a group or wing staff, the reporting should also go to the next higher headquarters. It is unknown if anyone outside the 92d Bomb Wing knew about Holland's bad behavior. Although too late, following the Czar 52 investigation, the service punished several leaders within the 92d Bomb Wing for dereliction of duty.[26]

Considering the damage and potentially deadly consequences a toxic pilot can have on an organization, it is worth the small investment in screening aviation candidates for toxic behavior, training aircrew to identify and respond appropriately to toxic pilots, and empowering anonymous reporting to prevent toxic leaders from negatively impacting flight safety and squadron culture.

Conclusion

The Czar 52 tragedy should have never happened. Despite multiple incidents proving Holland to be a rogue aviator, the 92d Bomb Wing's leadership failed to properly correct and prevent this toxic senior pilot from continuing to fly and exerting his influence over the wing's junior aircrew. The wing leadership also created a toxic environment in which Airmen began to lose faith in the institution over a double standard and refusal to acknowledge their legitimate concerns about a toxic pilot. The analysis of the crash and ongoing problems with toxic senior leaders in the cockpit in the 30 years since the incident reveal such leaders persist in gaining seniority in rank and flight qualifications.

Militaries with aviation communities must improve initial screening and training of aviation candidates to identify potentially toxic behavior, train aircrew on how to identify and respond to toxic pilots should an incident happen in flight, and finally empower anonymous reporting to hold a commanding officer accountable. At best, the failure to address toxic leadership in the cockpit can compromise the immediate and long-term health of the Air Force. At worst, it can have fatal consequences.

25. Merja Hoppe, "The Problem with Toxic Leadership and How to Detox Organizations" (working paper, ETH Zurich, February 2021), 9, http://dx.doi.org/.

26. Kern, *Darker Shades*.

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